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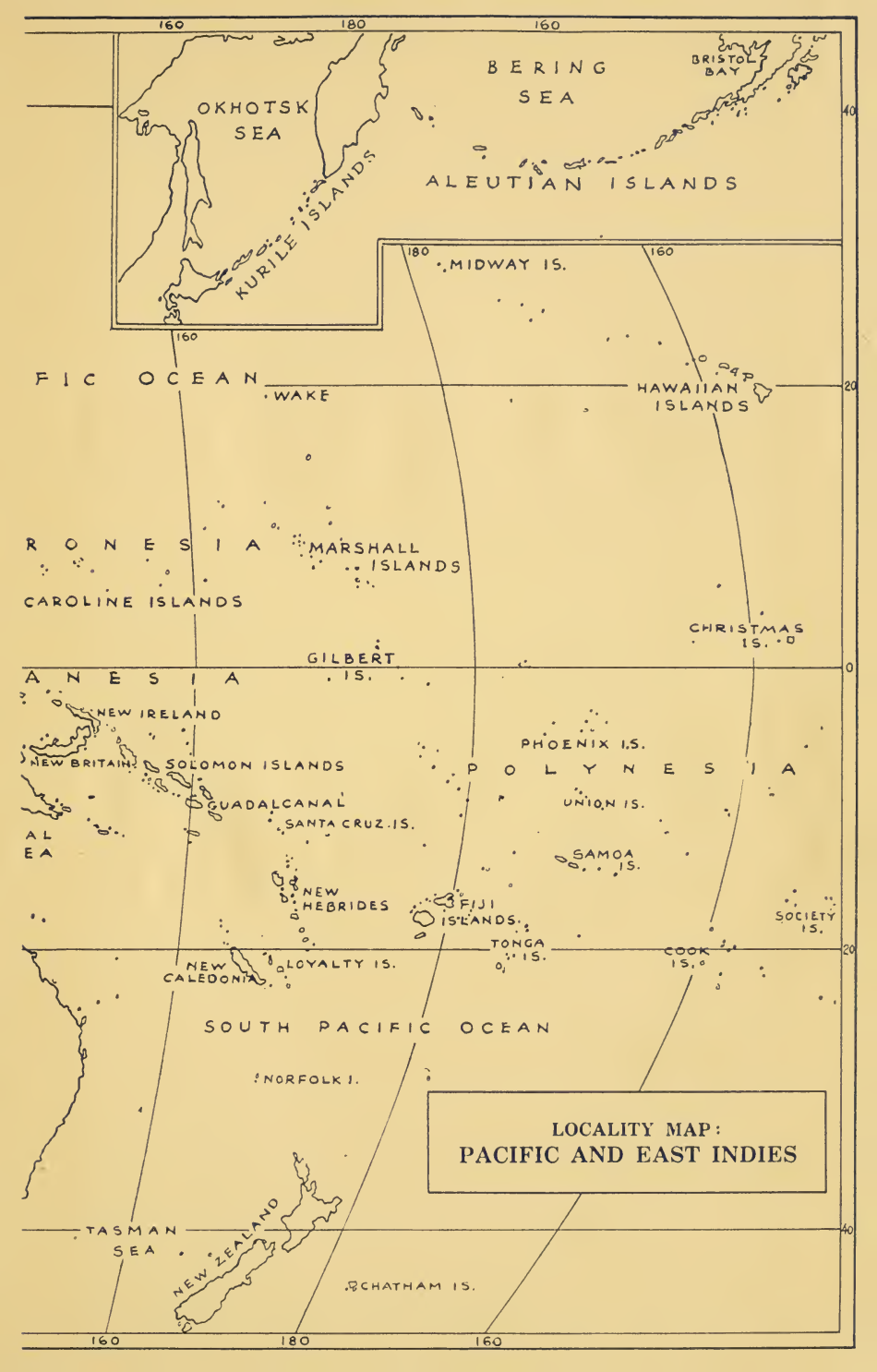
160
180
160
BERING SEA
BRISTOL BAY
OKHOTSK SEA
ALEUTIAN ISLANDS
KURILE ISLANDS
40
180
MIDWAY IS.
160
160
FIC OCEAN
WAKE
HAWAIIAN ISLANDS
20
RONESIA
MARSHALL ISLANDS
CAROLINE ISLANDS
CHRISTMAS IS.
GILBERT IS.
0
ANESIA
NEW IRELAND
PHOENIX IS.
NEW BRITAIN
SOLOMON ISLANDS
POLYNESIA
GUADALCANAL
UNION IS.
SANTA CRUZ IS.
AL EA
SAMOA IS.
NEW HEBRIDES
FIJI ISLANDS
SOCIETY IS.
TONGA IS.
COOK IS.
20
NEW CALEDONIA
LOYALTY IS.
SOUTH PACIFIC OCEAN
NORFOLK I.
LOCALITY MAP:
PACIFIC AND EAST INDIES
TASMAN SEA
NEW ZEALAND
40
CHATHAM IS.
160
180
160

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MAMMALS of the PACIFIC WORLD

T. D. CARTER - J. E. HILL - G. H. H. TATE

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Foreword

When "Pearl Harbor" made Americans conscious that the Pacific Ocean was about to become a vast theatre of military operations, it was apparent that many of the critical areas were only plaçes on the map to most people. Few persons knew anything about the appearance of the war areas, their geographical significance, or their wildlife and its environment. Most of the fighting was developing among islands, and there are thousands of these in the Pacific. Also there are great differences existing between various island masses, as for example the Aleutians and the Solomons.

Some of the islands are the home of unique animal life, to be seen nowhere else in the world. If military personnel were concentrated on certain of these islands it might mean that needless destruction of irreplaceable wildlife would result unless the military and others were told something about the natural history of the Pacific.

The American Committee for International Wild Life Protection resolved, in the winter of 1942, that something should be published to inform our armed forces about the wildlife they would encounter in the far reaches of the world's greatest ocean. Of course it was realized that when men are at war nothing in the natural environment would weigh against human life. But where conservation of the fauna and flora placed no obstacle before military expediency, it would be easier to arouse support for conservation if the public had available some simple account of the wildlife of the Pacific. The initial idea of the Committee expanded, and nine cooperating institutions eventually embarked upon the larger concept of an over-all picture of the Pacific World which will depict for the enlisted man and his

relatives a great variety of data. This is to be done in a series of handbooks.

So little has been written about the mammals on many of the Pacific islands that it is difficult for the layman to find information. By a fortunate coincidence the American Museum of Natural History has had a long and continuous interest in the south Pacific. Through the Archbold Expeditions it has done extensive field work in New Guinea and has acquired specimens from other islands. Because of this background, the authors of "Mammals of the Pacific World"—all of them in the Department of Mammals of the American Museum—are well qualified for their present undertaking. Dr. Tate has the special distinction of having observed and collected mammals in New Guinea.

Within the scope of the "Pacific World" the mammals of three continents are encountered. North America has contributed to the fauna of the Aleutians; from continental Asia come the mammals of Japan, Formosa, Sumatra, and other islands situated on the continental shelf; and finally Australia has supplied with characteristic representatives such islands as New Guinea and the Solomons. To complicate matters, some of the islands received their mammals as waifs on natural rafts or as passengers in the primitive craft of the aboriginal peoples. The whole topic of the distribution of the mammal life of the Pacific is intensely interesting and challenging to the imagination. When one learns that a creature has established itself on an island only after the operation of the laws of chance over a period of hundreds of thousands of years, he can appreciate the significance of conservation for that animal.

All of the mammals of the area are interesting. Some are obviously useful as food; some are dangerous and not to be provoked without hazard. Many of these animals such as bear, tiger, and kangaroo are already familiar to Americans, but a number of others peculiar to the area need to be described for an American audience. This book attempts to provide an intro-

ductory account of the most salient facts of origin, life history, and distribution. The field is so extensive, however, that no one island or no single species can receive very exhaustive treatment. A synoptic list with a greater number of species, but with less descriptive matter and discussion, has been prepared by Dr. Tate and published by the American Museum under the title "A List of the Mammals of the Japanese War Area." It is divided into four parts:

Part 1. New Guinea, the Solomon Islands, the Bismarck Archipelago, New Hebrides, and other remote south Pacific groups.

Part 2. The Greater Sunda Islands (Sumatra, Java, Bali), with Nicobar and Andaman Islands.

Part 3. The Lesser Sunda Islands (Lombok to Timor), the Moluccas, Celebes.

Part 4. Borneo and the islands of the South China Sea.

These are short booklets and were planned primarily for the Medical Services as an aid in knowing the mammals of an island and something of the possibilities of mammals as disease carriers.

Never before, to my knowledge, have data on the mammals of so great a section of the Pacific been brought within the covers of a single book. It is hoped that a wide circle of readers will find "Mammals of the Pacific World" instructive, entertaining, and useful. Certainly the authors have labored mightily to bring the facts before the public, and if a better understanding will help to promote conservation of wildlife in these remote places, a great deal will have been accomplished.

Harold E. Anthony, *Chairman and Curator*
Department of Mammals
American Museum of Natural History
New York City

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Table of Contents

		PAGE
	Foreword	v
	Introduction	xv
I.	Characteristics and Classifications of Mammals	1
	Distinctive Characters of Mammals	1
	Teeth	2
	Limbs	5
	Classification and Scientific Names	7
II.	Species of Mammals of the Pacific Area	11
	Egg-laying Mammals: Duckbills, Spiny Anteaters. Order Monotremata	11
	Pouched Mammals or Marsupials. Order Marsupialia	15
	Insectivores. Order Insectivora	37
	Flying Lemurs. Order Dermopter	44
	Bats. Order Chiroptera	45
	Apes, Monkeys, Lemurs. Order Primates	63
	Flesh-eaters. Order Carnivora	79
	Seals, Sea Lions, and Walruses. Order Pinnipedia	100
	Scaly Anteaters. Order Pholidota	107
	Gnawing Mammals or Rodents. Order Rodentia	108
	Rabbits and their Allies. Order Lagomorpha	123
	Whales and Porpoises. Order Cetacea	126
	Dugongs, Sea Cows. Order Sirenia	136
	Elephants. Order Proboscidea	137
	Even-toed Ungulates. Order Artiodactyla	139
	Odd-toed Ungulates. Order Perissodactyla	151

58455

PAGE

III. Distribution of Mammals in the Pacific Area 155

Origin and Evolution of Mammals 155
Evolution of Environments 156
Continental and Oceanic Islands 157
Range and Dispersal of Mammals 160
The Passage of Natural Barriers 161
Establishment of Species on Islands 163
Archaic Mammals Preserved on Islands 163
Biological Regions 164
Faunas of the Pacific Islands 166

IV. Conservation of Mammals 181

Need for Preservation 181
Collecting and Study of Specimens 182

Glossary 185

Alphabetical Index-Checklist of the Islands 189

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MASS.

Illustrations

Fig. 1. Mammalian teeth, exemplified by the teeth of the Marsupial Cat 3
Fig. 2. Examples of mammalian feet 6
Fig. 3. Generalized diagram of the mammalian "family tree" 9
Fig. 4. Straight-beaked Spiny Anteater 15
Fig. 5. Marsupial "Wolf" 17
Fig. 6. Tasmanian Devil 18
Fig. 7. Marsupial "Cat" 19
Fig. 8. Rabbit Bandicoot 22
Fig. 9. Australian Possum 23
Fig. 10. Striped Possum 24
Fig. 11. Spotted Cuscus (male) 26
Fig. 12. Lesser Flying Phalanger 28
Fig. 13. Koala 29
Fig. 14. Wombat 31
Fig. 15. Tree Kangaroo 35
Fig. 16. Common Gymnure or Moonrat 39
Fig. 17. Large Musk Shrew 41
Fig. 18. Common Tree Shrew 43
Fig. 19. Flying Lemur 44
Fig. 20. Typical Bat, showing parts of flying mechanism 46
Fig. 21. Flying Fox 47
Fig. 22. Tube-nosed Fruit Bat 49

Fig. 23. Head of Long-tongued Bat, showing protrusile tongue 49

Fig. 24. A. Tail of Sheath-tailed Bat; top view
B. Head of Slit-faced Bat
C. Head of False Vampire Bat
D. Head of Horseshoe Bat
E. Head of Leaf-nosed Bat 52

Fig. 25. A. Wing of Bent-winged Bat
B. Head of Tube-nosed Insectivorous Bat
C. Head of Australian Long-eared Bat
D. Ear of Trumpet-eared Bat
E. Head of Mastiff Bat 60

Fig. 26. Orang-utan 64

Fig. 27. White-handed Gibbon 65

Fig. 28. Celebes Ape 69

Fig. 29. Thomas's Leaf Monkey 70

Fig. 30. Proboscis Monkey 76

Fig. 31. Slow Loris 77

Fig. 32. Tarsier 78

Fig. 33. Malay Bear 80

Fig. 34. Yellow-throated Marten 81

Fig. 35. Teledu 83

Fig. 36. Malay Civet 87

Fig. 37. Little Civet 88

Fig. 38. Linsang 89

Fig. 39. Palm Civet 90

Fig. 40. Masked Palm Civet 91

Fig. 41. Small-toothed Palm Civet 92

Fig. 42. Short-tailed Mongoose 94

Fig. 43. Clouded Leopard 96

Fig. 44. Marbled Cat 97

Fig. 45. Leopard Cat 99

Fig. 46. Steller's Sea Lion 101
Fig. 47. Hawaiian Seal 106
Fig. 48. Pangolin 107
Fig. 49. Upper Right Cheek-teeth of Rice Rat, Black Rat, and Vole 108
Fig. 50. Asiatic Porcupine 122
Fig. 51. Brush-tailed Porcupine 123
Fig. 52. Hump-backed Whale 129
Fig. 53. Sperm Whale 130
Fig. 54. Common Dolphin 135
Fig. 55. Dugong 136
Fig. 56. Asiatic Elephant 138
Fig. 57. Asiatic Water Buffalo 140
Fig. 58. Tamarau 141
Fig. 59. Anoa 142
Fig. 60. Serow 143
Fig. 61. Sambar Deer 145
Fig. 62. Sika Deer 147
Fig. 63. Barking Deer 148
Fig. 64. Mouse Deer 150
Fig. 65. Babirusa 151
Fig. 66. Javan Rhinoceros 152
Fig. 67. Sumatran Rhinoceros 152
Fig. 68. Malay Tapir 153
Fig. 69. Faunal Regions of the World, showing probable greatest extent of land during the Ice Age 165

Front end paper: The Pacific Ocean and the East Indies

Jacket photograph, Courtesy of The Zoological Society of Philadelphia

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Introduction

Since the beginning of the Japanese war relatively enormous numbers of men and some women who never before dreamed of visiting the islands of the Pacific and the East Indies have found themselves transported thither. Everything about them there is new and strange. Not only do the various natives look and behave differently, but even the locally commonplace garden plants, useful woods, birds, animals, and insects look, sound, and act differently from the familiar kinds at home. This book, designed to introduce the mammals of this vast area to the newcomer, has been written as one of the parts of a series of handbooks on the Pacific, in course of preparation.

The animals are described as concisely as possible under their respective classes. Technical words have been generally avoided; in some cases the use of such words serves to prevent frequent repetition of explanatory clauses. The meanings of those words are defined in a short glossary placed before the geographical index.

So many geographical names have been given when indicating the places where animals are found that a map has been included to assist the reader to locate such names.

A discussion of the ancient history of the region from the standpoint of animal development and movement—how animals reached islands from their continental homes, how they survived after arrival, and the character of the evidence for such histories—is provided with the hope that interest in the subject may be aroused.

A few words are offered on each of the seemingly but not really contradictory subjects of conserving native animals and collecting specimens of them for scientific study.

The last part of this book is devoted to a geographical index arranged alphabetically. By turning to a certain group of islands, the reader can see at a glance what species of animals inhabit that group.

The illustrations of the various mammals were drawn by George F. Mason of the American Museum of Natural History. Several of the figures showing teeth and limbs are the work of Miss Janet Roemhild; the map was done by Miss D. F. Levett Bradley. It was based, with the exception of the insert of the Aleutian Islands, upon a projection prepared by the American Geographical Society, New York, 1942.

The authors wish to express their deep sense of gratitude to two members of the staff of the American Museum of Natural History—Dr. H. E. Anthony, Chairman of the Department of Mammals, and Mr. Childs Frick—for their unfailing interest and valued advice during the preparation of this book.

MAMMALS OF THE PACIFIC WORLD

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Characteristics and Classification of Mammals

Mammals are distinguished from other back-boned animals by having hair, which in a few kinds may be scanty, and by the fact that their females give milk and suckle the young. Also, in all but the egg-laying platypus and echidnas, the young are born alive. The term "mammal" is an attempt in one word to put into common language the idea that all of the thousands of different forms sharing the attributes just mentioned make up a single great class, distinct from the reptiles, birds, amphibians, and fishes. The Class Mammalia thus includes the beasts of field and forest, the aquatic whales, seals, and sirenians, the bats, and mankind. This idea is a relatively new one, dating from the Swedish biologist Linnæus in the second half of the eighteenth century. It has been accepted by most educated people but is still foreign to a large proportion of humanity.

DISTINCTIVE CHARACTERS OF MAMMALS

Mammals are grouped into Orders on the evidence of similarity of structure, reinforced by what has been discovered about the fossil history of the different groups. The members of orders are in most cases obviously more closely allied to each other than to other mammals. Thus, the flesh-eaters belong for the most part to the Order Carnivora (literally, flesh-eaters); the monkeys, the gnawing animals, the hoofed animals, the flying animals (bats) likewise are members of distinct orders. But exceptions occur; the pouched animals, including pouchless

ones whose ancestors had pouches, comprise meat-eaters, gnawers, monkey-like creatures, and forms with hoof-like toes like the kangaroos.

For prompt and easy recognition it is best to dwell chiefly upon those differences of shape or behavior which can be observed easily. In the field most mammals are unfortunately killed almost as soon as discovered, so it is best to emphasize differences of shape, size, and color. The structure of certain of the parts of mammals is frequently more distinctive and easy to see than that of other parts; the teeth and limbs notably provide definite indications of species, and usually agree with the evidence of other parts and with fossil evidence.

Teeth. Although the toothed whales may have as many as fifty teeth on each side of each jaw, other mammals never have more than that number all together. The Australian meat-eating pouched animals or marsupials may have a total of forty-six teeth (our opossum has four more); most other mammals have far fewer—at the most forty-four. The spiny and scaly anteaters have none, but lap up their insect prey with a long, sticky tongue; and the whalebone whales have replaced teeth with a horny set of sieves that retain engulfed small fish and shrimp-like animals for swallowing.

The teeth of mammals, except the simple, peg-like teeth of the toothed whales, consist of several sorts. They comprise front cutting-teeth, or incisors; pointed, often fang-like eye-teeth, or canines; narrowed cheek-teeth in the side of the jaw near the front, or premolars; and broader crushing-teeth near the back, or molars. In some kinds of animals the teeth of one class may assume the shape and function of another class. In many mammals all but the molars develop in two successive series, a milk or juvenal series, and a permanent or adult series which replaces the former. In pouched animals one tooth only in each jaw is so replaced. The toothed whales have only permanent teeth. Squirrels and porcupines among the gnawing mammals replace one or two cheek-teeth at about the time they

become adult, but the rat family and most remaining gnawers have no milk teeth.

The incisors, or cutting-teeth, may number three, two, or one on each side; some marsupials even have four upper incisors. They may be chisel-like or ever-growing, as in rodents

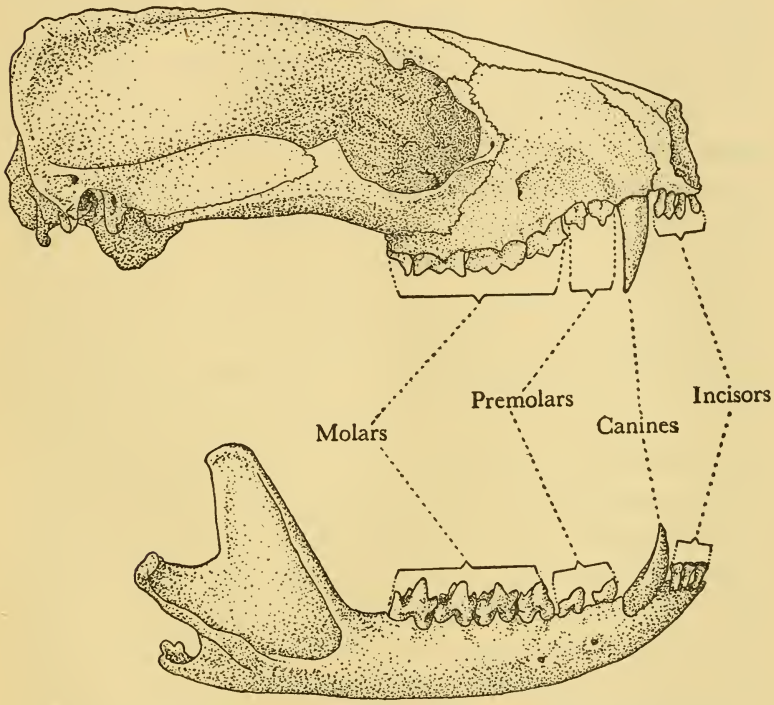

Fig. 1—*Mammalian teeth, exemplified by the teeth of the Marsupial Cat*

and rabbits; pincer-like, as in some insect-eaters; broad and spade-like, as in cattle and some monkeys; or small and almost useless, as in some bats. They are often about equal in size and shape, as in meat-eaters and monkeys; or the middle incisor may be much larger than the other, as in the rabbit, or lost completely, as in the upper jaw of some bats. Upper in-

cisors are absent in cattle and deer, while in the elephant the lower ones are missing and the two upper incisors are modified to form the tusks.

The canines, or eye-teeth, are usually longer and more rounded in cross section than the other teeth. While the upper incisors are set into the front upper jaw bone, the upper canine is the first tooth in the maxillary or side bone of the upper jaw. The lower canine fits in front of the upper one. Bats, meat-eaters, the seal group, and most monkeys, especially males, have large canine teeth. These teeth are tusk-like in pigs and dagger-like in the mouse-deer. They are the killing teeth of beasts of prey, the fighting teeth of these and animals such as pigs and monkeys which tear and hurt rivals. Rabbits, rodents, and most kinds of kangaroos have no canines; cattle and most true deer have only lower ones, similar in shape to the incisors.

In each toothrow the cheek-teeth, from few to as many as seven in number, stand behind the canine, or the gap (diastema) which is present when this tooth is undeveloped. In elephants only one enormous grinder with parts of others is used at a time. The tooth, as it wears away, travels forward in the jaw and the next behind it moves upward and forward gradually to take its place. These teeth are very large. Their grinding surfaces may have fifteen or twenty cross-ridges of hard enamel which make the teeth efficient mills to grind leaves and twigs. The grinders of other plant-eaters such as rhinoceros and tapir, cattle and deer, have different patterns; but the ridges, whether they are shaped like the Greek letter π or are crescent-like, serve similar purposes.

The cheek-teeth of many meat-eaters are reduced in number, and a pair of very large ones on each side works together like shears to cut up meat. The cheek-teeth of bears, otters, and many of the civet family have mound-shaped cusps, better suited for crushing than shearing. Insect-eaters and the insect-eating bats have sharp-cusped teeth for crushing and cutting up hard-bodied insects.

In mammals that eat almost everything—plant food, small mammals, insects, and eggs—the cheek-teeth also have rounded, mound-like cusps. Such are present in the pigs, some rats, bears, and most primates. The leaf monkeys have sharp-cusped teeth which chop up leaves. In many rats the cusps form cross-ridges or zig-zag patterns.

Limbs. The limbs, next to the teeth, provide the best external guides for recognizing and classifying mammals. The several different kinds of limbs are all modifications of single basic patterns of the fore and hind limbs. By reduction or enlargement of various parts, involving changes in proportions, hands, flippers, wings, paws, and hooves have evolved. Only whales and sirenians, which have lost all but internal traces of the hind pair, lack four limbs. The front limbs of these animals have become steering paddles, while the tail has become flattened and enlarged to provide propulsion. The seals and their allies likewise have converted their front limbs into paddles. Their broadened hind feet are used somewhat like the whale's tail, moving up and down in the water.

The hoofs of hoofed mammals, both those with odd and those with even numbers of toes, are nothing but enlarged fingernails and toenails. In most of them the central toe, or pair of toes, is enlarged in order to bear most of the weight. Moreover, the bones of the hand and foot are lengthened, a condition which is an advantage in running.

The slow-moving, massive elephant, which has hoof-like nails, walks partly on the tips of the toes and partly on a pad of fatty tissue. The foot-bones are short, the limb-bones long and massive.

Meat-eaters, rabbits, rodents, insect-eaters, flying lemurs, scaly and spiny anteaters, and pouched mammals have claws. Some meat-eaters, rabbits, and rodents walk on their toes; in these, pads are developed under the joint between the free finger or toe and the hand or foot, and other pads are formed at the tip of each toe. The other clawed mammals, including the bear

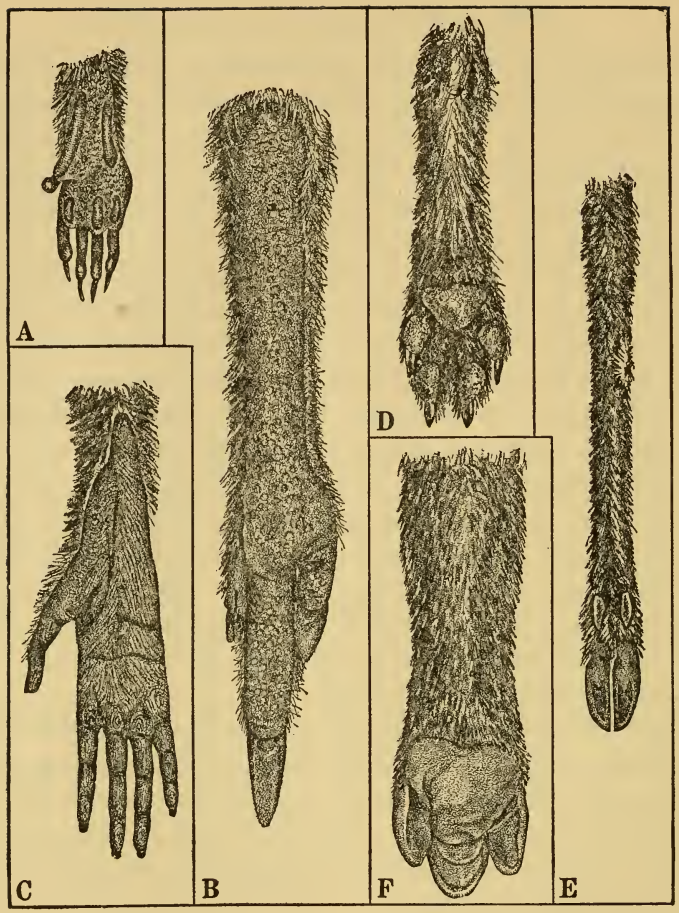

Fig. 2—*Examples of mammalian feet*

A. *Marsupial cat: Clawed, five-toed foot, the entire sole is used in walking;* B. *Kangaroo: Lengthened foot; the first toe is absent, the second and third united, while the fourth toe is the greatest;* C. *Monkey: Opposable first toe; friction ridges on the sole which is used in walking;* D. *Dingo: Lengthened foot in which walking is done on the clawed four toes. Foot pads well developed;* E. *Deer: Even-toed, hoofed and lengthened foot. The weight is borne by the third and fourth toes, while the second and fifth toes, dew-claws, are much smaller and set higher in the foot;* F. *Tapir: Odd-toed hoofed mammal. The chief toe is the middle one, while the third and fourth are less developed or even absent.*

and weasel families among the meat-eaters, walk on their flat feet and hands.

Monkeys and their allies usually walk on their palms and soles, and most have nails rather than claws. The lemurs and tarsiers have claws on some toes and nails on others. The gibbons and orang-utan swing from branch to branch suspended by their long arms; they seldom come to the ground.

Bats have hook-like claws on their hind feet and thumbs. The rest of the fore limb is greatly modified. The bones of the arm and hand are lengthened; the third finger alone may be longer than the bat's body, and the forearm (the part between wrist and elbow) is almost as long. This bony framework is covered with nearly naked, elastic skin extending between the hand and ankle, and frequently also between the legs and tail. The skin between the hind legs and tail is called the interfemoral membrane. It is used as a brake and rudder. The hind limbs are so constructed that the knee bends backward.

CLASSIFICATION AND SCIENTIFIC NAMES

It is a part of human nature to group things in orderly arrangements and to abstract general ideas. The animal world is so complex that unless it is arranged and thought about systematically, it cannot be well understood. Men have been classifying mammals in various ways for thousands of years. They divided them into those that were good or bad to eat, or those that were harmless or dangerous. In the Bible a different classification was made: animals with divided hoofs which chewed the cud were considered fit to eat; the rest were "unclean." Modern classification is based instead on fundamental similarity of structure and what we know about the evolution and descent of animals from common ancestors.

Since man is a mammal, he may be chosen to illustrate different stages in a simplified classification. The Class Mammalia is divided into two Subclasses; man is placed in the Subclass

Theria (often called Eutheria) with all modern mammals; the egg-laying duckbill and spiny anteaters are placed in the other Subclass, Prototheria. Man is next classified as a member of the Order Primates. Dogs and cats, on the other hand, go in the Order Carnivora; and pigs, deer, and cattle are considered members of the Order Artiodactyla. Nineteen such Orders of living mammals are recognized; sixteen of them are dealt with in this handbook. The Orders Hyracoidea (Hyraxes or conies of Africa and Palestine), Tubulidentata (African aardvarks), and Edentata (armadillos, sloths, and anteaters—South American for the most part) are not represented in the Pacific region.

The basic system of classification of living mammals is indicated by the accompanying diagram or phylogenetic tree (p. 9).

Many of the orders of mammals have no inclusive common name. Especially is this true when they contain mammals that appear quite different from one another; even dogs and cats are different enough to make the idea of the Order Carnivora a difficult one. The less obvious relationships among mammals have been recognized only during the last two centuries, which is too short a time for the names given these groups to mean much to the average person. However, it is useful to have common names for groups, even if they are not familiar and if they are merely anglicized forms of scientific names. Whenever such names are introduced in this handbook an attempt at explanation will be made.

Each order of mammals is subdivided into families. Man belongs to a family group of his own, the Family Hominidæ. Other families of the primates comprise the apes (Pongidæ), gibbons (Hylobatidæ), Old World monkeys (Cercopithecidæ and Colobidæ), the tarsier (Tarsiidæ), the slow loris and some other lemurs (Lorisidæ). There are still other families of South American and Mascarene primates, as well as extinct families known only from fossils.

Some families contain only one living genus, the next lower step in classification. Man belongs to the Genus *Homo*. With the exception of the larger and more striking mammals, treatments in this book are confined to the genus. Most genera are easily recognizable. Many species, on the contrary, can be dis-

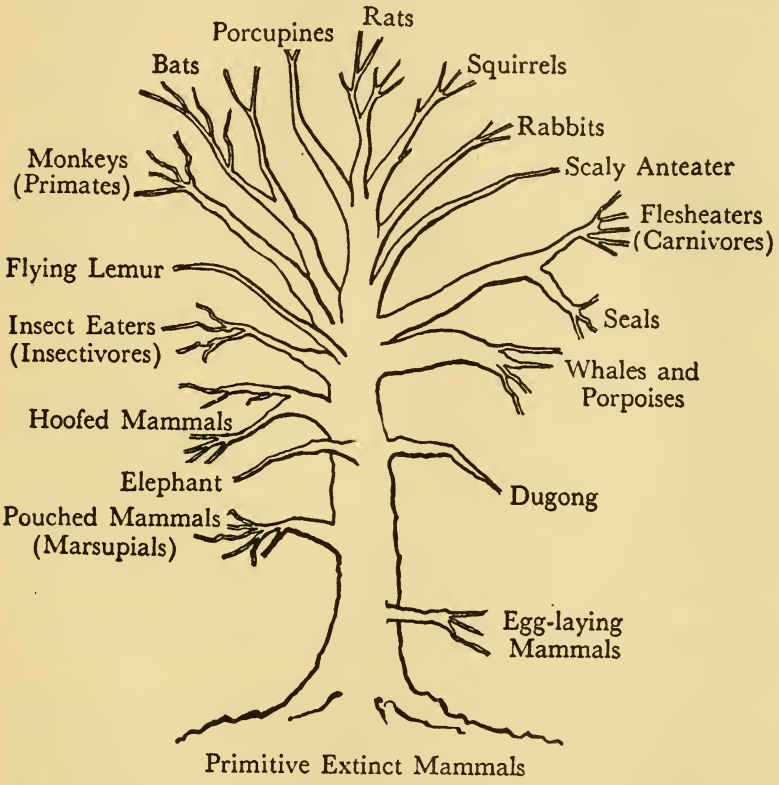

Fig. 3—*Generalized diagram of the mammalian "Family tree"*

tinguished only with difficulty. This handbook would be unwieldy were it to attempt to give descriptions of every species in each genus. The species to which man belongs is *Homo sapiens*. *Homo*, the generic name, in Latin means "man"; *sapiens*, the specific name, means "wise." Linnæus, the founder

of scientific classification and nomenclature, gave man this name.

The scientific name of a species always consists of two words: the first or generic name, analogous to a surname, begins with a capital letter; the second or specific name, equivalent to a Christian name, in Zoölogy begins with a small letter. Scientific names should be printed in italics.

In technical work races or geographic varieties, called subspecies, are often recognized. A third Latin name is added to the specific name of a new variety, and the second name of the variety originally described is repeated. Man is divided into several races; the white race bears the scientific name *Homo sapiens sapiens*. In this handbook little attention except in the monkeys is paid to such races because of limitations of time and size. But the idea underlies much of the discussion.

Finally we come to that indivisible element, the individual. Just as no two people are entirely alike, and as a human race contains many diverse individuals, so wild mammals vary individually; no two are precisely alike. This individual variation has been appreciated only recently, and its study is a difficult and lengthy task. Only by accumulating large numbers of specimens can it be solved, which is one reason why many of the mammals described here are of doubtful status—why we do not always yet know whether they are actual species, races, or merely individual variants.

Measurements of mammals in scientific and foreign books and articles are usually given in units of the metric system, commonly in millimeters. In this book, for the convenience of those who do not readily estimate size in this more efficient system, inches, feet, and yards are used. To find the metric equivalents, inches are multiplied by 25 to give millimeters.

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2

Species of Mammals of the Pacific Area

Egg-laying Mammals: Duckbills, Spiny Anteaters. Order Monotremata

Only in Australia and New Guinea are there mammals that lay eggs and suckle their young. They are of two main types: the velvet-coated Duckbill or Platypus, and the Spiny Anteaters or Echidnas.

The Duckbill. Family Ornithorhynchidæ

The Duckbill or Platypus (*Ornithorhynchus*), though humorously described as half bird and half animal, is nevertheless a true mammal. The jaws and front of the face project as a rubbery or horny duck-like "bill" and are covered with hairless, tough skin. The bill is made to appear more duck-like by the lack of teeth. However, in unborn duckbills teeth are present. These are lost during development.

The fur of the duckbill is close and velvety, and colored dark grayish brown. It shows the sheen commonly observed on other aquatic animals such as otters and Australian water rats. The tail is relatively short and stumpy. The feet are webbed for swimming and the hind foot of the male bears a horny spur, at the base of which is a gland containing a poisonous secretion. Very young females also have spurs which, however, become atrophied soon after the body length exceeds nine inches. Males are much larger than females. The total length of males is twenty-four inches, and of females eighteen inches, the tail of each being about one-fourth of the total length.

The food consists of snails, aquatic larvæ, worms and cray-

fish mixed with mud. Long burrows are made in the banks of rivers, usually with two entrances—one of them below water. The nest, made of grass, leaves, rootlets, and reeds, is placed in an enlarged chamber at the inner end of the burrow. Usually two or three eggs are laid, which are about seven-tenths of an inch in length and only slightly less in diameter. The eggs have horny white shells and become stuck together by means of a sticky substance with which they are coated. It is estimated that they hatch through the warmth of the mother's body in about two weeks. The newly hatched young have not developed the "duckbill" but have a hard, sharp process or "caruncle" on the muzzle. They are said not to nurse for nearly a week. After that the mother secretes milk through two milk patches (not nipples), wetting the hairs thereon, which the young suck. Scratching with their caruncles by the young is thought to start the mother's milk flowing.

Recently important new facts concerning the life habits of the platypus have come to hand.[1] These relate to a mother and a young one bred at Badger Creek Sanctuary, Healesville, Victoria, Australia. In the non-breeding season the platypus spends a very large part of the twenty-four-hour day seeking food at the bottom of its swimming tank. It eats enormous amounts of animal food, the quantity of which probably rises to a peak when it is nursing its young. At that time, in the Sanctuary, a single night's food (which incidentally cost about five dollars per day) comprised four hundred large earthworms, three hundred and thirty-eight beetle grubs, and thirty-eight small crayfish. The total weight of that food was one and three-fourths pounds. Since the maximum live weight of the animal was only two pounds, digestion must have taken place almost concurrently with feeding. Maintenance of extreme activity—swimming, digging, and giving of milk to the young platypus—requires relatively very large amounts of that easily assimilable vital fuel.

[1] Fleay, D., 1944, Animal Kingdom, New York, 47, pp. 51–69.

When not seeking food the animals are active making or altering the long earthen burrows which they mine in the banks of streams. The building of the nest which will contain the eggs and young takes place about twelve days after mating, in October. To prevent shrinkage the eggs must be kept in a saturated atmosphere. Quantities of leaves and grass, soaked in the water, are gathered together, then wadded into tight packets beneath the tail, and so are carried to an enlarged nest chamber at the end of one of the tunnels. A series of earthen plugs is maintained between the nest chamber and the several outlets. They are believed to keep the atmosphere of the chamber moist by checking air movements. Nest building is a strictly "business" affair. When working at it the mother practically stops feeding; she completes nest construction with the water-soaked leaves in some eighteen hours. The first egg is apparently laid within a day or two, the developmental period of the egg within the mother's body having lasted about fifteen days.

Incubation of the eggs requires some nine to ten days more. During that time the mother platypus remains in her burrow for periods of several days at a time. She eats little or nothing and emerges merely to defecate. After the hatching of the eggs the mother reverses her time-table; she again spends many hours in the water feeding ravenously, and between times retires to the burrow to feed the babies. For the first few days after the eggs have hatched the mother seems to secrete no milk. During that time she scratches the mammary area of her body a great deal, which activity possibly helps to induce her milk to flow. She does not wean her young until they are about four months old and nearly as large as herself. At approximately that time the mother develops a fine new coat of glossy fur.

The baby platypus is a singularly helpless creature, quite as helpless as a human baby. It remains unable to crawl until it has grown almost as large as its parent, the only movements of its limbs being feeble scratching efforts. It is nursed by the mother until it is almost fully grown and has attained the weight

of one pound. Until it is more than two months old it seems unable to maintain its body heat; the skin becomes cold when the mother is away from it. At two months the body length is only nine inches, the eyes are still unopened, the beak is short, the fur barely developing. At three months, the body length is thirteen inches, the eyes are fully open and alert, the bill straight but still short, and the fur well developed except on the tail. The animal can utter a shrill growl. Movement is still uncertain and slow. At three and one-half months the body length is thirteen and one-half inches, and the young animal can crawl better. And at four months, although the body has grown no longer, the baby can crawl actively and come out from the burrow to the water for its first swim and first food not provided by its mother. In the wild state where conditions are less favorable for the mother, the babies may be forced to leave the nest somewhat earlier, when they are smaller and less able to fend for themselves.

Spiny Anteaters. Family Tachyglossidæ

These are heavy-bodied animals with the skins covered with short, sharp spines mixed with hairs. They are almost tailless, and with a snout so much elongated that they look like large, beaked hedgehogs. Teeth are absent at all stages of development. The eggs are carried and hatched in the pouch, not placed in a nest as is done by the platypus.

The Straight-beaked Spiny Anteater (*Tachyglossus*) has a nearly bare snout, which is used for rooting and digging in soft soil. The legs are powerful; the feet are furnished with long digging claws, with which the animals can bury themselves in the ground with astonishing speed. But it is stated that they do not make tunnel-like burrows. Their color is brownish gray with basal parts of the spines whitish. Their length is from fifteen to twenty inches.

The food consists mostly of termites but doubtless beetle grubs and other soft-bodied insects are also eaten. They are

found in most of eastern Australia, Tasmania (where the hair in the coat of the local race is much more developed), and southern New Guinea.

The Curved-beaked Spiny Anteater (*Zaglossus*) is a much larger and heavier animal than *Tachyglossus*. The bill is not only downwardly curved but proportionally much longer, while

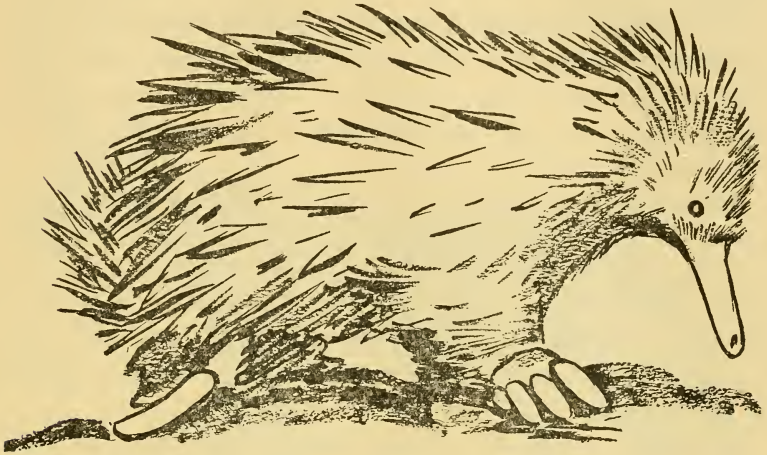

Fig. 4—*Straight-beaked Spiny Anteater*

the first and fifth toes are reduced in size. A quite dense hair covering partly hides the spines, much as in the Tasmanian spiny anteater. The color varies from brownish black to much paler, depending upon the amount of white in the spines. The total length is about thirty inches.

This spiny anteater is reported to live in burrows in rocky places and to feed on ants. It is found in New Guinea and Salawati, where it seems mainly confined to mountainous areas.

Pouched Mammals or Marsupials. Order Marsupialia

The marsupials are the descendants of an ancient and primitive group of mammals. They are customarily divided into two

groups, those with only one pair of incisors or front teeth in each side of the lower jaw (Diprotodontia) and those with several lower incisors (Polyprotodontia). Kangaroos, phalangers, honey possum, and wombats are diprotodonts; bandicoots, "native cats," "pouched mice," and banded anteaters are polyprotodonts. But bandicoots are almost as closely related to diprotodonts.

In all animals of the diprotodont division and in the bandicoots of the polyprotodonts, the second and third toes of the hind foot are very small and united. This strange condition, which may serve as a combing device, gives the appearance of a toe equipped with two claws.

Not all marsupials are characterized by a pouch in the female (the male never has a pouch), but most of them have this nursery bag in which to carry the young. In some types the pouch opens backward. In males the scrotum is situated in front of the penis. All marsupials and monotremes of both sexes have a pair of bones projecting forward from the pelvis in the wall of the abdomen.

Newborn marsupials are tiny, hairless creatures with well-developed hands. They find their way hand over hand through the mother's fur into the pouch or to the region of the teats. Each becomes attached by its mouth to a teat and the mother pumps milk into it by contractions of the muscles covering the milk glands, for it is too small to suck.

Apart from a few American marsupials, common opossums and their relatives, these animals are found today only in the New Guinean-Australian region, with representatives on the islands from Celebes and Timor to the Solomons. Ages ago, during the days of dinosaurs, they were also widely distributed in Europe. Many pouched animals in southern New Guinea are so closely related to those on the Australian mainland that they are considered only racially distinct.

Meat- and Insect-eating Marsupials. Family Dasyuridæ

Wolf-like, weasel-like, and rat-like marsupials have all of the toes independent. Four incisor teeth are seen on each side of the upper jaw, three in the lower one; the cheek-teeth have sharp cusps and the upper ones are usually triangular in shape.

The Marsupial "Wolf," "Tiger," or Thylacine (*Thylacinus*), now confined to Tasmania and possibly approaching extinction

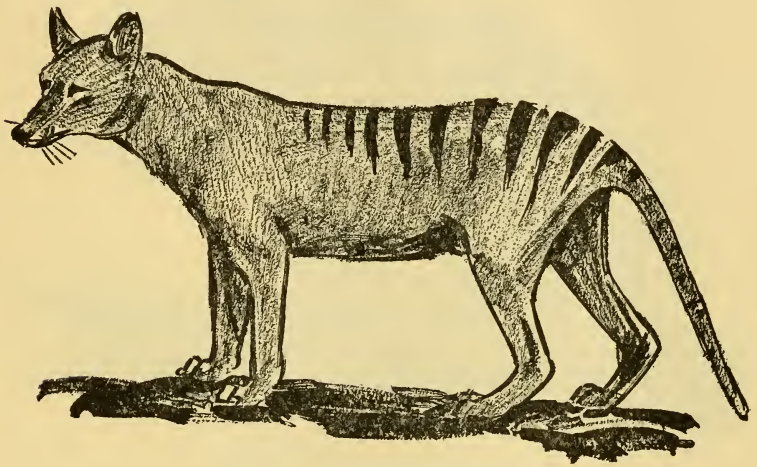

Fig. 5—*Marsupial "Wolf"*

there, is the counterpart among marsupials of the true wolf. The snout is rather long, the ears shorter and lower than those of northern dogs and wolves, and the tail is thick at the base, long and tapered. Its color is brown, with a series of blackish brown stripes parallel to the ribs, which begin near the shoulders, reach their maximum length in the rump and thighs, and cease a short way beyond the base of the tail. The pouch, opening backward, contains four nipples. Two to four young are born.

The marsupial wolf is about the size of a collie dog; its overall length is sixty-five inches, including the twenty-inch tail.

In the natural state these animals probably ate wallabies and other Tasmanian mammals, but as they took to killing sheep in numbers after their introduction, they were nearly exterminated. The animals are nocturnal, spending the day concealed in dens in hilly country. They are reported to be shy, but if cornered to turn savagely on dogs employed to hunt them. The voice consists of a series of "husky or guttural coughing barks."

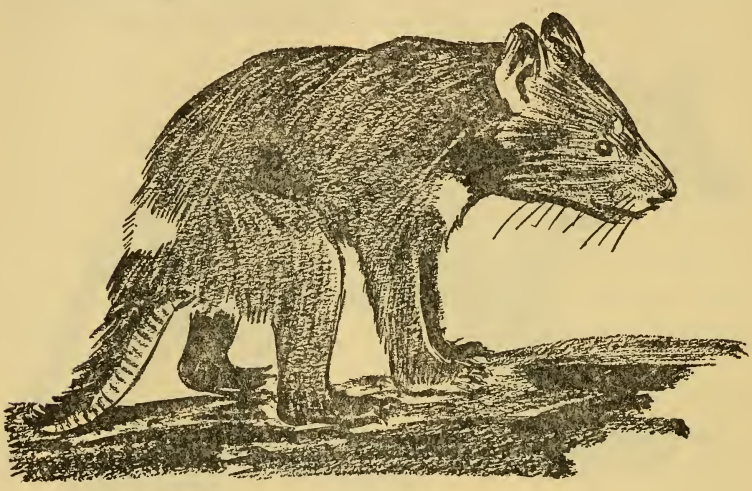

Fig. 6—*Tasmanian Devil*

Fossil evidence proves that these marsupials were widely distributed in Australia before the advent there of man.

The Tasmanian Devil (*Sarcophilus*) is a somewhat ungainly animal, colored blackish, with a few white spots on chest, sides, and rump. The hind quarters are weak and the tail is considerably shorter than the body, but the jaws are exceedingly powerful. The pouch, which contains two pairs of teats, opens backward. The total length is forty inches, including the twelve-inch tail.

Tasmanian devils are markedly carnivorous, raiding chicken roosts and possibly killing young sheep. Their natural food

consists of small wallabies, rats, ground birds, and lizards. The animals are cunning, intractable, and savage but if caught very young make docile and amusing pets. They are found now only in Tasmania, but formerly inhabited the Australian mainland.

The Marsupial "Cats" or "Tiger Cats" or Dasyures (*Dasyurus*), which comprise several species, look more weasel-like than

Fig. 7—*Marsupial "Cat"*

cat-like. They are the size of a small cat or the American little spotted skunk—about nineteen inches in total length, including the tail which is about nine inches. They are reddish brown or olive-brown in color, marked with white spots on the head and body. A well-developed pouch is present in females, which may contain four to six young. The dasyures feed largely on rats, birds, and insects. Around settlements they are disliked because of their fondness for poultry. The marsupial "cats" or dasyures are widely distributed in Australia. One species occurs on New Guinea but does not extend to the adjacent islands.

The Marsupial "Mice" (*Phascogale, Dasyuroides*, and allies) live chiefly on insects, but they may also eat flesh and some vegetable matter. They are the size of rats and mice, nine to sixteen and one-half inches in total length. The tail is three and three-fourths to eight inches long, usually less than the length of head and body, but in some species it is equal to this or slightly longer. The snout is long and pointed, and the tail in some species is densely haired, as in tree shrews. The females of some species have pouches. Those of others have poorly marked folds of skin around the area of the mammæ. In certain species of *Sminthopsis*, one of which is found in New Guinea and the Aru Islands, the thickened tail serves for storage of fat. One genus (*Antechinomys*), which has developed long legs, hops like a jumping mouse. The New Guinea marsupial mice are less varied and specialized than those of Australia.

Banded Anteaters. Family Myrmecobiidæ

The banded anteater (*Myrmecobius*) is a specialized relative of the marsupial "cats." Externally it resembles a long-snouted ground squirrel. Its rather harsh coat is colored bright rufous brown above and whitish beneath. On the back, parallel to the ribs, is a series of six or seven white stripes. It has long claws but does not make burrows. The tongue can be extended far out of the mouth. *Myrmecobius* is peculiar in possessing more than the usual number of teeth; an extra molar can be seen in each jaw. No pouch remains; the nipples are four in number. The food consists principally of termites which are swallowed whole.

This beautiful little animal is now found only in southwestern Australia and appears there to be threatened with extinction. A second species which occurred in Victoria and New South Wales has not been seen for many years.

Bandicoots. Family Peramelidæ

The bandicoots have in general long, narrow feet with long claws, tapered, pointed snouts, and rather short tails. The

pouch opens backward. The less specialized bandicoots occur in New Guinea and nearby islands; more specialized types—the rabbit bandicoot and the pig-footed bandicoot—are found in Australia only.

The Australian Bandicoot (*Perameles*), which includes also the banded bandicoots of southern Australia, has rather coarse gray-brown pelage and moderately large ears. These animals are nocturnal insect-eaters, and generally inoffensive. Their total length is about twenty inches.

The Spiny Bandicoot of New Guinea (*Echymipera*), also gray-brown, occurs all over that island below three thousand feet and also on the Bismarcks, Japan, Waigeu, Aru, and Kei. The size is variable—from ten to twenty inches.

The Long-legged Bandicoot (*Peroryctes raffrayana*) occurs only in New Guinea. The adult size is about thirty inches from nose to tip of tail, of which the tail accounts for about eight inches. The mountain bandicoot, a smaller relation (*P. dorsalis*), has finer fur and a black stripe along the middle of the back.

The Ceram Bandicoot (*Rhynchomeles*) is much like *Peroryctes.*

The Short-faced Bandicoots (*Isoodon*) are light gray-brown in color. The hair is wiry and not at all spiny. The tail is proportionally long. The total length is eighteen inches, of which the tail measures seven inches. Widely dispersed in northern Australia, with representation in the savannas of southern New Guinea and Port Moresby, these bandicoots are characteristic of grassy regions.

The Shrew Bandicoot (*Microperoryctes*), found only in the mountains of Dutch New Guinea, is black. It is exceptionally small, measuring about nine inches from nose to tip of tail.

The Rabbit Bandicoot or Bilby (*Macrotis*) is one of the oddities of nature. It is a soft-haired, pale gray-brown bandicoot with white underparts, with a well-haired, moderately long tail and very large, rabbit-like ears. Two kinds are known, both from the southern half of Australia. The total

Fig. 8—*Rabbit Bandicoot*

length is twenty-seven inches, with the tail measuring nine inches.

The Pig-footed Bandicoot (*Chœropus*) has feet with claws less pointed and more hoof-like than have others of the family. The ears are quite large, although not so large as those of the rabbit bandicoot. Unlike its insect-eating relatives, this bandicoot feeds wholly on leaves, bulbs, and fruits. The total length is fourteen inches, including the four-inch tail. It was found formerly through the greater part of Australia, except the north, but now is in danger of extinction.

Marsupial Mole. Family Notoryctidæ

The Marsupial Mole (*Notoryctes*) is highly peculiar and primitive, possibly an offshoot of the bandicoot family. The eyes and external ears are obsolete. The hands, provided with heavy claws, are adapted for excavating soil, and the feet are used to drive loosened earth backward in the burrow. The snout and tail have tough skin coverings. The pouch opens backward. The fur is fine and silky, its color yellowish white, varying to tawny. The total length is six to six and one-half inches; tail, one inch.

Like true moles, the marsupial mole lives at high pressure,

consuming huge amounts of food, mainly worms and insects, and spends much of its time digging.

Possums, Cuscuses, Flying Phalangers. Family Phalangeridæ

This large family includes the following general types of marsupials: possums, striped possums, mouse possums, cuscuses, ring-tails, flying possums or gliders, and honey possum. Some are squirrel-like, others lemur-like, others mouse-like, and yet others resemble flying squirrels.

The Australian Possum (*Trichosurus*) is one of the best-known members of the family. Its coat has been used exten-

Fig. 9—*Australian Possum*

sively in the fur business. Although somewhat squirrel-like, these animals differ by their prehensile or grasping tails and by their large, cat-like ears and pointed noses. The head resembles that of our ring-tailed cat of the southwestern United States. The color is highly variable—gray in some races, blackish brown in others. The fur of the body and tail is dense except

on the prehensile surface. The size is approximately thirty inches from nose to tip of tail; tail, eleven inches. It is found in most of Australia.

The Striped Possum (*Dactylopsila*) is distinctly marked lengthwise with three broad black stripes on a whitish gray ground color—a very conspicuous pattern. The tail is whitish.

Fig. 10—*Striped Possum*

The head and ears are formed much like those of the common possum but the tail has even less tactile surface; the fourth finger of the hand is the longest. The total length is about twenty inches, of which nearly one-half is tail. The animal is nocturnal; its food is made up of fruit and insects. New Guinea is the headquarters of this species, a single race being found in northern Queensland.

A related striped possum (*Dactylonax*), found only in New Guinea, has the fourth finger of the hand drawn out into a slender probe-like structure nearly twice as long as the corresponding finger of *Dactylopsila.* This finger may perhaps

be used to insert into worm-holes or bees' nests in trees to dislodge insect food.

Mouse Possums, Pygmy Possums, Dormouse Phalangers (*Eudromicia* and allies) are tiny, mouse-like possums with long, nearly bare, prehensile tails. The color is some shade of brown, with underparts white. The over-all length is eight to ten inches; tail about five inches. These little animals are nocturnal, feeding on insects and fruit. Several species are known in Australia but only one in New Guinea.

The Feather-tailed Mouse Possum (*Distoechurus*), found only in New Guinea, is a rare animal, nearly equal in size but not closely related to *Eudromicia*. The tail is fringed with a row of long hairs on each side which give it a feather-like appearance.

The Cuscuses (*Phalanger*) are slow-moving, tree-living, prehensile-tailed, monkey-like marsupials, with small ears almost buried in the dense fur. Several main types occur: the gray or striped cuscuses, which have black, reddish, and brown varieties, the ursine or blackish cuscus of Celebes, and the spotted cuscus, in which the male only is spotted. The pouch opens forward. One or two young occupy it at a time.

The cuscuses are all vegetarians. They are chiefly nocturnal and spend the day concealed in masses of vines or foliage or in hollow trees.

The Gray Cuscuses (*Phalanger orientalis*) are represented all over New Guinea and the adjoining islands including the Solomons. Representatives are known on the Moluccas and on Celebes, as well as on Wetar and Timor. In the mountains of New Guinea a species (*P. vestitus*) with long silky fur is known. The length is generally thirty to thirty-six inches, of which fourteen to sixteen inches are tail.

The Bear Cuscus (*Phalanger ursinus*) is a large brownish black species, the hairs plentifully grizzled with white, which is found on Celebes, Salayer, and Talaut Islands. Its actions are sluggish.

The Spotted Cuscus (*Phalanger maculatus*) is one of those rare kinds of animals in which the color pattern of the male is sharply different from that of the female. In New Guinea, north of the mountains, the general colors are brown and white, the males having the brown back strongly spotted with white, the females with the back unspotted. South of the mountains

Fig. 11—*Spotted Cuscus* (male)

males have in addition blackish brown spots on the rump; the females have a blackish rump, more or less silvered with white. In Queensland the males of the local race are predominantly white with gray spots. The females are gray above and white beneath. The total length is three and one-half feet, of which almost half is tail. The spotted cuscuses are present also in New Britain and on the Admiralty Islands.

The Ring-tails (*Pseudocheirus, Petropseudes*) are a large group of cuscus-like marsupials found in both Australia and

New Guinea but not on the islands. They have dense, rather soft hair, strongly prehensile tails (hence the common name), and the thumb and forefinger together are opposable against the other three digits. Characters of their teeth separate them sharply from the true cuscuses and indicate distant relationship to the koala or native bear. All have vegetarian diets and all but *Petropseudes* live in rain forest, where they are strictly arboreal. Five or six very distinct species occur in New Guinea, and nearly as many more in eastern Australia. The size, dependent upon the species, varies from that of a red squirrel to that of a cat.

The Rock-haunting Ring-tail (*Petropseudes dahli*) of the Northern Territory of Australia is characterized by its short tail, which barely equals half the length of head and body which is eighteen inches.

The Flying Phalangers (*Petaurus, Acrobates, Schoinobates*), locally called flying squirrels, are among the most interesting and delightful of the Australian pouched animals. All are built on the plan of the American flying squirrel, with broad membranes attached to front and hind limbs by means of which they glide downward from tree to tree. It is interesting to note that this type of locomotion has developed twice independently in the marsupials, since *Petaurus* and *Acrobates* are relatives of possums and cuscuses, while *Schoinobates*, the largest of the flying phalangers, nearly a yard in length, is allied to the ring-tails and koala. All have forward-opening pouches, are nocturnal, and eat fruit and insects.

The Lesser Flying Phalanger (*Petaurus breviceps* and allies) is a brownish gray, soft-furred animal with white or buffy underparts. The size is about fifteen inches, including the eight-inch tail. It is found throughout New Guinea and on New Britain, Aru, and the Gilolo group of islands. In Australia it is represented by very similar forms.

The Yellow-bellied Flying Phalanger (*Petaurus australis*) is considerably larger. The color is dark brownish gray above,

Fig. 12—*Lesser Flying Phalanger*

yellowish white beneath. The length is almost thirty inches, of which seventeen inches are tail. It is found in eastern Australia from southern Queensland to Victoria.

The Pygmy Flying Phalanger (*Acrobates*) is a tiny species, grayish above, white beneath. The length is about six inches, nearly half of which is tail. It is distributed from Queensland to Victoria.

The Greater Flying Phalanger (*Schoinobates*) has very long, soft fur. The ears are large and naked, and the tip of the tail prehensile. In the present species the flying membrane is attached to the elbow, not to the wrist, as in those described before. In color it is dark ashy gray above, varying from blackish to quite pale gray; underparts are whitish. The length is thirty-six inches, including the twenty-inch tail. Its range is Queensland to Victoria.

The Koala or "Native Bear" (*Phascolarctos*), one of the favorite Australian mammals in zoological gardens or in pictures, appears bear-like only because of its chunky build and tailless condition. The fur is dense, woolly, and gray in color.

Fig. 13—*Koala*

The ears are short, limp, heavily furred, and the hands agree with those of the ring-tails in having the index finger together with the thumb opposable against the other fingers. The head and body are thirty to thirty-two inches long.

These rather lumbering tree-climbers have the ability to spring from one nearly upright branch to another vertical

branch several feet away. The food is restricted to certain types of eucalyptus leaves, notably those of gray and blue gum trees in Queensland and New South Wales and the manna gum in Victoria. A single young one is born at a time which, after developing in the backward-opening pouch, commonly rides on the mother's back. The koala is distributed from Queensland to Victoria, in parts now very scarce or extinct.

The Honey Possum (*Tarsipes*), a tiny creature distantly related to the mouse possums, has a long muzzle, a greatly extensible tongue, and a long tail with prehensile tip. The general color is chestnut-brown on the sides, and on the back there are three blackish longitudinal stripes separated from each other by buffy whitish stripes. The well-developed pouch contains four nipples; the number of young carried therein is from one to four. The total length is about seven inches; tail, about four inches. The honey possum, which has weak teeth, feeds on the nectar and pollen of flowers and small insects. The animals are nocturnal climbers; they may be gregarious, a number living together in one hole. They are found only in southwestern Australia.

The Wombats. Family Vombatidæ

In this small family are contained the marsupial counterpart of our woodchucks. Although descended probably from tree-dwelling ancestors they have acquired many characters that fit them for burrowing. The bodies are thick and heavily muscular, the limbs powerful, the claws heavy and strong, but the tail is a mere rudiment. The length of head and body is about forty inches. The pouch contains only two nipples; usually only one young one is born. These nocturnal animals feed upon vegetation—grasses, roots, bulbs, and fungi. Although wombat burrows up to one hundred feet long have been measured, most are much shorter.

Four species of rather similar appearance are known, belonging to three genera (*Vombatus, Lasiorhinus, Wombatula*).

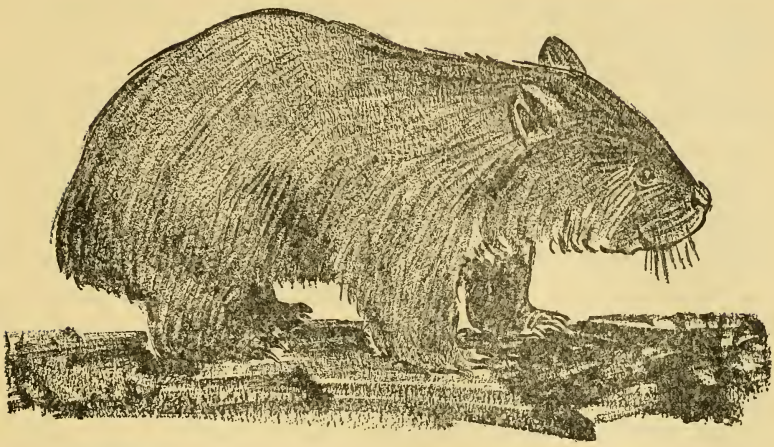

Fig. 14—*Wombat*

Their range includes only Australia and Tasmania; in many parts of the former, wombats are now extinct.

Kangaroos and Wallabies. Family Macropodidæ

The kangaroo family is marked by the long hind feet adapted for two-legged hopping and leaping, the long stout tail generally used as a prop, single lower incisor tooth separated by a considerable space from the cheek-teeth. Pouches open forward, and a single young one or "joey" is as a rule nursed at a time. Almost all are plant-eaters.

The largest kangaroos belong to the genus *Macropus*. Many of the species are becoming rare. The visitor to Australia will probably see only some of the many kinds of medium-sized or small species, collectively termed wallabies.

The Red and Gray Kangaroos (*Macropus rufa* and *M. major*) are the two best known of the large kangaroos. The red kangaroos commonly show a grayish or "blue" phase, thus somewhat resembling the true gray kangaroo, but may be distinguished by the strongly defined black whisker-mark on each side of the nostrils, which is edged beneath with white. The red

kangaroos are restricted to the inland plains of New South Wales but they had formerly a far wider range.

The gray kangaroo or forester inhabits open forests and brush from northern Queensland to South Australia, and distinct races appear in southwestern Australia and in Tasmania.

A third type of large kangaroo, the **Wallaroos or Antilopine Kangaroos** (*Osphranter*) which haunt rocky places, have relatively shorter, stockier limbs than have *Macropus*. The tip of the muzzle between the nostrils is hairless (in *Macropus* it is more or less hairy). A good many kinds of wallaroos have been distinguished, and both red and gray kinds exist among them. The total length may reach eight feet, of which three feet make up the length of the tail. The typical wallaroo ranged originally from Queensland to Victoria; the antilope wallaroo, its close relative, lives in the Northern Territory of Australia. Still another race of wallaroo occurs in the southwest of Australia.

The wallabies include a far wider assortment of animals than do the large kangaroos. They include four general groups of animals of typical kangaroo appearance: sand wallabies, pademelons, rock wallabies, and hare wallabies.

Sand or Agile Wallabies (*Wallabia*) and allies include some seven species, among which may be mentioned the pretty-face, black-tailed, red-necked, black-gloved, and agile wallabies. These names relate to their distinctive characters and serve fairly well to distinguish them. A white hip-stripe is seen in several. One, the agile wallaby, is known beyond Australia; in southern New Guinea and on the savannas about Port Moresby a race of this wallaby is common. The size is variable, but generally the over-all length is about five feet, of which the tail measures two and one-half feet.

The Pademelons or Scrub Wallabies (*Thylogale, Setonix*) are generally smaller than the wallabies of the "agile" group. Many of the Australian forms are reddish brown or chestnut on the nape and hind legs, while distinct offshoots found in

New Guinea (*T. browni* and others) are colored dark chocolate-brown. Examples are red-necked, red-legged, red-bellied, dama, and white-throated pademelons, of which the dama alone is relatively uniform in color. The red-legged pademelon has recently been found in the extreme south of New Guinea.

A distinctive species, the **Short-tailed pademelon or Quokka** (*Setonix*), occurs in Western Australia. It is a little smaller than most; the size from nose to tip of tail is thirty-three inches, of which the tail includes ten inches.

The Gazelle-faced Wallabies (*Dorcopsis*), a group found only in New Guinea, are superficially like the dark brown pademelons. They can be distinguished by their nearly naked ears and particularly by the hairs of the back of the neck which are arranged so that they lie forward from a hair-whorl just behind the shoulders, whereas in *Thylogale browni* the hairs begin at the back of the head and lie smoothly and continuously down the neck and back. *Dorcopsis* is also distinguished by the greatly lengthened premolar teeth. *D. brunii*, the commonest of these wallabies, is a lowland species inhabiting forested areas of southern New Guinea. A second species (*D. hageni*), with a thin white line down the back, is found on the northern side of New Guinea, and a tiny third species (*D. macleayi*) with long lax hair is known only from the high mountains of that island above ten thousand feet.

The Rock Wallabies (*Petrogale* and *Peradorcas*) are small animals about the size of the pademelons. The tail is long and of more uniform thickness than in the wallabies thus far described. It is less seldom used as a third hind leg to prop up the animals' bodies. At least five types of rock wallabies are known, most with white shoulder and hip-stripes, and one with the tail distinctly ringed with dark brown (*Petrogale xanthopus*).

The Nail-tailed Wallaby (*Onychogale*) is a distinct group of three species, all of which have a horny projection at the tip of the tail.

The Hare Wallabies (*Lagostrophus, Lagorchestes*), the smallest of the wallabies, are so named for their hare-like speed and their habits of crouching close and solitary on "forms," like hares. The banded hare wallaby (*Lagostrophus*), known only in Western Australia, is conspicuously patterned with transverse blackish marks across the back on a ground of brownish gray. The remaining species of hare wallabies (*Lagorchestes*) have dark backs and a wash of red on the outside of the thighs (whitish in *L. conspicillatus*, which has also a reddish patch around each eye).

The Tree Kangaroos (*Dendrolagus*) are a specialized offshoot of the kangaroos and wallabies, whose legs, still of leaping type, have nevertheless become shorter and more massive. The foot pads are granular; they assist in climbing. Six quite distinct species with several geographical races are known, four from New Guinea and two from Australia.

Tree kangaroos reach a total length of four feet approximately, of which the tail equals about half. All are agile climbers and some can make downward leaps of thirty feet with remarkable sureness.

Matschie's Tree Kangaroo (*D. matschiei*), with bright golden chestnut upperparts and golden yellow tail, appears restricted to northern New Guinea. A close relative (*D. goodfellowi*) with dark bands on the tail, inhabits the slopes of the central ranges of New Guinea.

Doria's Tree Kangaroo (*D. dorianus*) is grayish brown, with a yellow-brown patch on the rump, at the base of the tail. It lives in the central ranges of New Guinea.

The "Bear-like" Tree Kangaroo (*D. ursinus*) is a brownish black species, with the hair tips occasionally frosted with white. It is found only in western New Guinea.

The Grizzled Tree Kangaroo (*D. inustus*) is brownish gray with the hair tips heavily grizzled; the tail is sometimes nearly all white. It is found only in the western half of New Guinea.

The Australian species, **Bennett's** and **Lumholtz's Tree**

Fig. 15—*Tree Kangaroo*

Kangaroos (*D. bennetti* and *D. lumholtzi*), are dark gray-brown, the former without strong markings. Lumholtz's tree kangaroo has the legs, cheeks, and forehead clear buff color. Both live in the mountains of northern Queensland.

The Rat Kangaroos (Subfamily POTOROINÆ) are considerably less kangaroo-like than are the wallabies and true kangaroos. Their ears are small and rounded and the claws of the hands are large, to suit their scratching and digging habits. The hind legs are nevertheless elongate and well adapted for leaping. Three main groups occur:

The Short-nosed Rat Kangaroos (*Bettongia*) include four species, all of which are brownish gray with whitish underparts. The distribution of the group is limited to southeastern Australia, Tasmania, and southwestern Australia.

The Rufous Rat Kangaroo (*Aepyprymnus*) is the largest of the rat kangaroos. Its total length is a little less than three feet, of which the tail measures fifteen inches. It is reddish gray with underparts white.

The Long-nosed and Broad-faced Rat Kangaroos (*Potorous*) are all dark reddish gray, with pale underparts, and look even more rat-like than those just described. The hind foot is considerably shorter than the head, and locomotion is more nearly on all fours.

The ranges of two of the long-nosed rat kangaroos are respectively southeastern Australia (*P. tridactylus*) and the extreme southwest of Western Australia (*P. gilberti*); that of the broad-faced rat kangaroo (*P. platyops*) is southwest Western Australia.

The Musk Kangaroo (*Hypsiprymnodon*) is regarded as the most primitive animal of the kangaroo family. It is also the smallest. The teeth are least specialized for eating grass and leaves, and the hind foot has five toes. The first toe, absent in other kangaroos, is movable and clawless. The tail is hairless, covered with scaly skin. The musk kangaroo is dark reddish brown, slightly paler beneath. The total length is eighteen

inches; tail, six to seven inches. A strong musky odor is given off. The diet is more generalized than that of most kangaroos; besides roots and fruits, insects and worms are eaten. It is restricted to Queensland.

Insectivores. Order Insectivora

In the islands with which we are concerned, the insect-eaters are represented by hedgehogs, gymnures (rat-like insectivores), shrews, moles, and tree shrews. Most of these feed on insects and have sharp-cusped cheek-teeth; the cusps looked at from above are arranged in the shape of the letter W. The incisor teeth are pincer-like in most cases. The muzzles are long and pointed, projecting well beyond the mouth opening. Insectivores usually have five toes on both fore and hind feet, and they walk on the whole sole and palm rather than on the toes as dogs and cats do. The first or inner pair of incisors is usually the largest and the canine is either like the incisors or like the first cheek-teeth.

Although the small shrews are often mistaken for mice, the gymnures for rats, and the tree shrews for squirrels, the incisor teeth of these insectivores are not chisel-like, there is no large gap between the incisors and the cheek-teeth, nor are the cheek-teeth modified for grinding. These differences, together with the characters given above, should be sufficient to distinguish the insectivores from any of the rodents.

This order is a very ancient group and contains the most primitive of the placental mammals. It is thought that most of the higher orders have been derived from early insectivores. The flying lemurs or colugos of the Order Dermoptera (p. 44) are probably closely related, and the bats may have developed from the same stock as these gliders. The tree shrews are thought by many to be ancestral to the primates (monkeys, etc.), and some authors place them in that order. They are included here because, although no doubt related to the primates, they have more in common with the insectivores.

Hedgehogs and Gymnures. Family Erinaceidæ

The Hedgehogs (*Erinaceus*), although widespread in Europe, Africa, and Asia, are not known from the Malay Subregion but they are found in Formosa. They are stout-bodied mammals, about ten inches long, with short legs and tail; the back and sides are covered with a dense coat of sharp spines. When alarmed a hedgehog puts its head and feet underneath its body and curls up into a ball, the spines all erected and projecting in every direction. Most hunting mammals leave hedgehogs alone. These spiny insectivores feed on worms, slugs, snakes, and small mammals, in addition to insects. The four or five young are nearly naked when born and are protected from enemies and the weather in a nest constructed of leaves and grass.

American porcupines are sometimes wrongly called "hedgehogs," but the only things the two kinds of mammals have in common to confuse people are their spines. Those of the hedgehog are firmly anchored to the skin and are not left in a wound like the barbed quills of the American porcupine. True hedgehogs are not found in America.

The gymnures are hairy, rat-like relatives of the hedgehogs. They lack spines. Instead of these they have long, coarse hair overlying woolly fur, and their tails are naked and rat-like. Their skulls and teeth are very similar to those of the hedgehog, and this is true of their other internal structures.

The Common Gymnure or Moonrat (*Echinosorex*) is twenty to twenty-four inches in total length, the tail being about one-third of this. The head and body are often particolored, blackish and white, or entirely white. This insectivore is found in the Malay region from Burma and Siam to Sumatra and Borneo.

The Lesser Gymnure (*Hylomys*) is brown and has a short tail, only about an inch long; its over-all length is about six

inches. The lesser gymnure shares the range of its larger relative and also reaches Java.

The Mindanao Gymnure (*Podogymnura*) is known only from Mount Apo in the Philippines. It is a gray species with long reddish brown guard hairs. Its total length is about eight

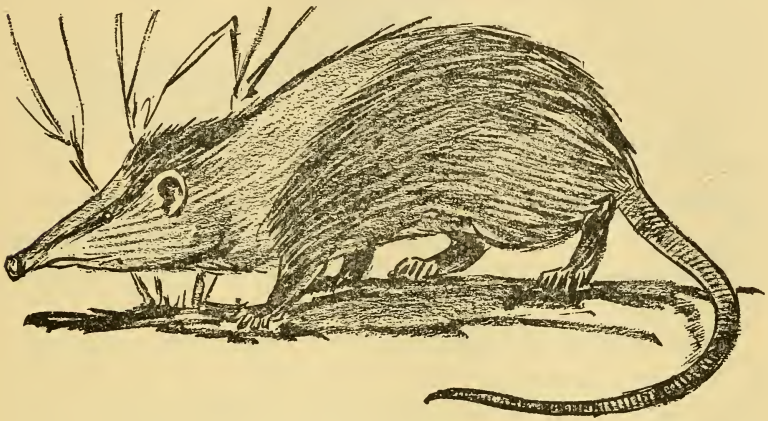

Fig. 16—*Common Gymnure or Moonrat*

and one-fourth inches, with the tail a little less than two and one-half inches.

Gymnures feed largely on termites and cockroaches, common in their habitat, but other insects are not refused. They have a rather disagreeable garlic-like odor, and are not appreciated as food by many carnivorous mammals.

Shrews. Family Soricidæ

These sharp-nosed little mammals are often confused with rats and mice. They are true insectivores, however, and form a rather uniform group. They are found almost everywhere except in Australia, Oceania, and the greater part of South America. The ears are round and usually hairy, the snout long and flexible, the eyes small, and the two-cusped front up-

per incisors project forward as well as downward. In the skull the cheek arch is incomplete.

Red-toothed Shrews (*Sorex*) are the commonest insectivores of the northern parts of the world. Species are found in Japan, the Kuriles, and the Aleutians. The Aleutian shrew, its toes fringed with long hair, is partly aquatic in habit. Only one specimen has been collected and that many years ago on Unalaska Island. These shrews feed largely on insects, grubs, and snails, but often eat vegetable matter also. In Alaska they may get into flour and cereals in storage and do great damage, much as house mice do.

Two Long-tailed Shrews (*Soriculus, Chodsigoa*) are found in Formosa. They are close relatives of the common red-toothed shrews but have fewer teeth; their teeth also have red tips.

White-toothed Shrews (*Crocidura, Suncus*) are often called musk shrews, because of their disagreeable odor. In addition to having white teeth, they have scattered long bristles on the short tail, mixed with short inconspicuous hairs. Various species occur in Europe, Asia, and Africa, on the Malaysian islands east as far as Timor, and on the Philippines, Formosa, and Japan. Most of the shrews of the islands are about the size of mice. One of the smallest mammals known belongs to this group.

The Large Musk Shrew or House Shrew (*Suncus murinus*) is about ten inches long, of which the tail comprises four inches. It is carried about on native boats like the house mouse, and in consequence is widespread. In India people say that if one of these shrews walks over a bottle of wine it ruins the flavor, even through the glass. This may be exaggeration, but the scent is very powerful, offensive, and lasting.

The house shrew makes a peculiar chatter as it runs about, a noise somewhat like the jingle of coins. For this reason the natives of some regions call it the "money mouse." Besides living in houses, it often inhabits swamps and the margins of

ponds. It feeds largely on cockroaches and other insects that frequent houses, but it also eats some of the food intended for human consumption. When cornered it bites fiercely. Cats frequently kill musk shrews although they do not eat them.

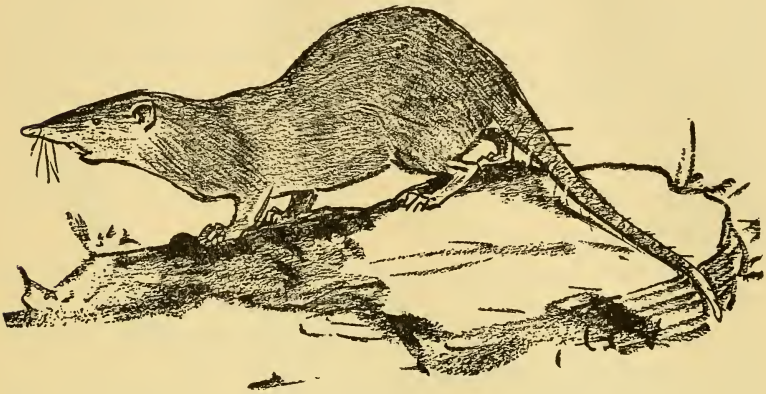

Fig. 17—*Large Musk Shrew*

The Asiatic Water Shrews (*Chimarrogale*) occur in the mountains of Japan, Borneo, and Sumatra. Their teeth are white, unlike those of the American water shrews. The toes of their large hind feet are fringed with stiff hairs and their fur is like long-piled velvet, coarser but more silky than that of land shrews. They are grayish or brownish black above and white below, and are among the largest shrews—about eight inches in total length, the tail about three inches. The body is heavier than that of the house shrew, which has similar dimensions. Water shrews usually live in swift streams; they are said to walk along the bottom feeding on the water insects and probably also on fish and amphibians. The entrances of their burrows are usually under water.

Moles and Their Allies. Family Talpidæ

Most members of this family make burrows and live under ground. The fur is short and velvet-like, the front feet broad,

and the snout long. The first upper incisor is not much larger than the others and is simple in contrast to that of shrews. In the skull the cheek arch, although slender, is complete.

The Hairy-tailed Shrew Moles (*Urotrichus, Dymecodon*) occur in Japan but in none of the other islands included in this discussion; related moles are found in western United States. They are small; the body is a little larger than that of a mouse, with the tail slightly shorter than the body. Their front feet are not broadened noticeably, but the claws are long. They emerge from the ground more frequently than other moles and dig by scratching out the soil from holes more like rodents or dogs.

True Moles (*Mogera*) of Japan and Formosa are closely allied to those found in China and southern Asia. They resemble the common moles of the United States and Europe in their general torpedo-like shape and short tail, hardly longer than the hind foot. The front feet are broad and almost round in shape; there are no external ears, and the minute eyes are hidden by the fur. These moles are blackish in color, like most species, and are a little less than six inches in total length, with the tail about one inch, excluding the hairs. Other kinds of moles are found in the Malay Peninsula, but they do not reach the islands.

Moles may be said to swim through the ground, using a breast stroke, in their search for earthworms, snails, and grubs, and they constantly use the tough-skinned, elongate snout to pry the soil apart. For this method of burrowing they require damp, fairly soft earth and thus are absent from areas where the soil is rocky, dry, or barren. They are very active, especially after a rain, and have been reported to make a run almost a hundred yards long in a single night. Considering the size of the mole, a man would have to dig a tunnel several miles long in the same length of time in order to equal the work of this mammal. Ridges mark the course of the superficial runs, the earth having been pushed up and to each side, but

earth from the deeper burrows is pushed up in symmetrical, rounded mole-hills.

Tree Shrews. Family Tupaiidæ

The Common Tree Shrews (*Tupaia*) resemble squirrels in habits, color, bushy tail, and the shape of the hind feet. They are distinguished from squirrels by their long, pointed noses. They have five toes on the front feet. Their upper teeth con-

Fig. 18—*Common Tree Shrew*

sist of two incisors on each side, a small peg-like canine, and six check-teeth; the fourth and fifth cheek-teeth (first two molars) have the cusps arranged in a W-pattern and are much broader than the other teeth. The orbit (eye-socket) is completely surrounded by a bony ring, and the cheek arch is complete. Tree shrews feed on insects, leaves, and fruit, and occasionally the eggs and young of birds. They are often active during the day-time. Tree shrews are found from India, Burma, and southern China to Borneo, Bali, and the Philip-

pines. The common tree shrew is known in the Philippines only from Palawan Island.

The Pen-tailed Tree Shrew (*Ptilocercus*) is found in Borneo, Sumatra, and the Malay States. It is dark brownish above, with yellowish cheeks and white underparts. A black mask runs from the eye to the nose; the tail is chiefly blackish but the feather-like tuft at its end is mixed with white. It is not at all common.

Slender-tailed Tree Shrews (*Dendrogale, Urogale*), their tails without the bushiness of the common kind or the feather-like tuft of *Ptilocercus*, occur in Indo-China and Borneo. *Urogale* is restricted to Mindanao, the Philippines.

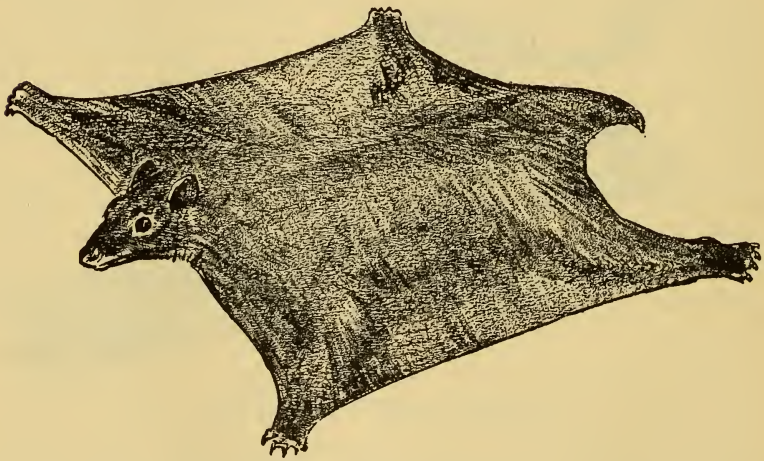

Fig. 19—*Flying Lemur*

Flying Lemurs. Order Dermoptera. Family Cynocephalidæ

The Flying Lemurs (*Cynocephalus*), sometimes called cobegos, colugos, or caguans, are about the size of a large squirrel. The face is somewhat dog-like, the limbs and tail long. A broad, thin membrane of furry skin stretches from the neck

to the thumb, between the fingers, from wrist to ankle, between the toes, and from the end of the long outer toes to the tip of the tail. This animal shows the highest development of the gliding adaptation; the membrane is much more extensive than that found in the flying squirrels. Although it provides no motive power, the colugo can control its direction. It can glide about seventy yards, and even in the still air of the forest loses little altitude. The fur is very soft and fine. The color varies from grayish to dark brown or chestnut mottled or blotched with silvery white. Flying lemurs are nocturnal animals, living chiefly on leaves and fruits. They are found from the Malay Peninsula and Siam to the Philippines, Borneo, and Java.

Bats. Order Chiroptera

The bats are an old and very distinct order of mammals. No other furred animals have wings or can actually fly. Those other mammals which make use of air resistance, such as flying lemurs, flying squirrels, and flying phalangers, glide by wide "planes" of skin stretched between the front and hind limbs, but none of these provides its own flying power. Different as bat wings are structurally from those of birds, they are almost as efficient.

The wing of a bat consists of the framework, like the ribs of an umbrella, formed by the greatly elongated bones of the hand, fingers, and arm, and the thin, elastic, generally naked skin which covers the frame and extends between the front and hind limbs. An additional membrane, the interfemoral membrane, often connects the tail with the hind legs but this may be reduced or absent. The thumb is free, its claw hook-like. The hind feet are provided with sharp, hook-like claws, by which bats attach themselves to branches or walls of caves or buildings and hang head downwards. This is the common position. Measurements in bats are especially important. They are usually measured as to head and body length, tail length, and length of the forearm, from wrist to the elbow.

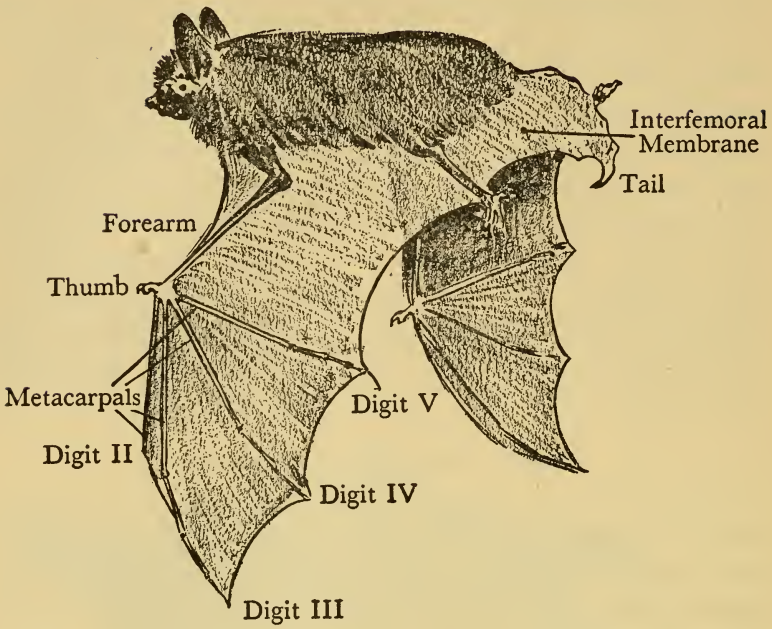

Fig. 20—*Typical Bat, showing parts of flying mechanism*

There are two major divisions of the Bat Order—the usually large fruit bats and the insectivorous bats, almost all of small size.

Fruit Bats. Suborder Megachiroptera. Family Pteropodidæ

Although some members of this family are small, with a body about the size of a mouse and the wing-spread less than a foot, most fruit bats are large, the largest having the head and body about a foot in length and the wing-spread as much as five feet. The face is usually fox-like, but in a few species has a short, rounded profile. The tail is often absent, and when present is usually short. The cheek-teeth are generally blunt-crowned; even when the cusps are sharp they do not form the W-pattern of insectivorous bats. Fruit bats are an Old World tropical

group, found also in Africa and southern Asia; they occur north to Japan and the Bonin Islands and east to the Caroline Islands and Samoa. They are unknown on the Marshall, Gil-

Fig. 21—*Flying Fox*

bert, or Ellice groups, and in New Zealand, but they are found in northern and eastern Australia. Fruit bats are rather closely related, and in spite of small differences, are included in a single family, the Pteropodidæ.

The Flying Foxes (*Pteropus* and a number of allied genera) are the most widespread of the fruit bats in the western Pacific islands, extending north to southern Japan and as far east as Samoa. In Australia five species are recognized, at least one of which is found as far south as the Victorian border. These tailless bats have a fox-like face with a long slender muzzle. Most bats of this group spend the day hanging in trees, often in great numbers. They fly long distances at dusk to find fruit or flowers over apparently well-established flying-ways. The flesh of most is palatable, if the animals have been skinned carefully to prevent the fur from touching it.

Short-nosed Fruit Bats (*Cynopterus* and several closely related genera) are restricted to the Oriental region, from India and the Philippine Islands east to Celebes. These bats usually have a short tail. One or two tailless forms are restricted to Borneo, Sumatra, and the Malay Peninsula.

Dog-faced or Rousette Bats (*Rousettus*), occurring throughout Africa and the Indo-Australian region, extend east as far as the Solomons but are not known from Australia. The muzzle of these bats is a little shorter and heavier than that of the flying foxes. The tail is short.

Spinal-winged Fruit Bats (*Dobsonia*) are much like dog-faced bats, but the membranes of their naked wings are attached to the body along the midline of the back rather than along the sides. The posterior half of the back is naked, and the index finger of the wing lacks a claw. The tail is as long as the hind foot. Spinal-winged bats are found from Celebes, Bali, and Sumba to the Solomons and Queensland.

Tube-nosed Fruit Bats (*Nyctimene*, *Paranyctimene*) have their nostrils drawn out into tubes projecting beyond the rest of the muzzle, which is shorter than in other fruit bats. The well-marked tail is almost as long as the lower leg. No lower incisors are developed, the lower canine teeth being in contact. The color is brownish gray, with the wings and ears usually spotted with yellowish; in most species a dark brown stripe

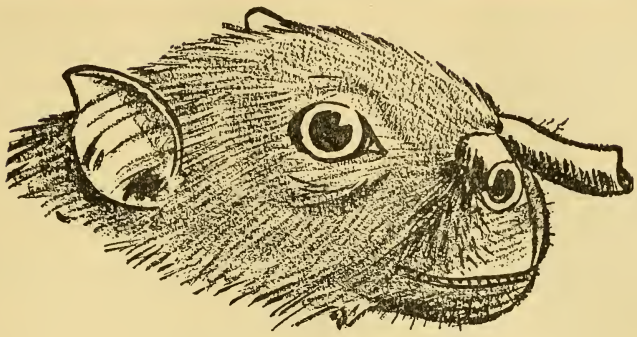

Fig. 22—*Tube-nosed Fruit Bat*

extends down the back. Tube-nosed fruit bats are found from Celebes and Timor to Queensland and Guadalcanal Island in the Solomons.

The Harpy Fruit Bat (*Harpionycteris*) resembles the flying fox externally. It is chocolate-brown and has cusped cheek-teeth. It is small, the forearm about three and one-fourth inches, the head and body about five and one-half inches. It is found only in the Philippines and Celebes.

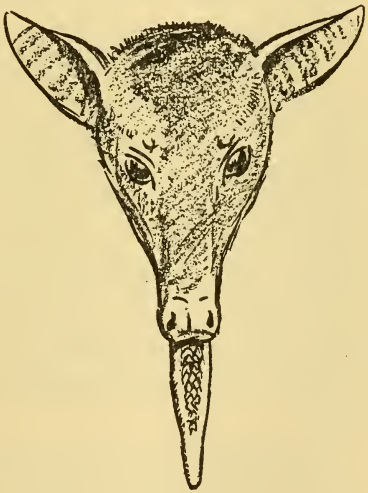

Fig. 23—*Head of Long-tongued Bat, showing protrusile tongue*

Long-tongued Bats (*Macroglossus* and related forms) have a long, highly protrusible tongue and narrow cheek-teeth that hardly show above the gums. They are small, the head and body length four and one-half inches or less, the forearm not more than about two and three-fourths inches. *Eonycteris*, superficially much like *Rousettus*, has no claw on the index finger. It reaches from

Sumatra eastward to Celebes and the Philippines. *Melonycteris* of the Bismarck Archipelago and the Solomons has very dark—almost blackish—underparts; and *Nesonycteris* from the same group of islands is cinnamon-colored above and gray beneath.

The Long-tailed Fruit Bat (*Notopteris*) of the eastern Melanesian Islands, resembles the spinal-winged bat (*Dobsonia*) both in having no index claw and, as its technical name implies, in having the wing membranes attached along the spine. The tail is about as long as the forearm, which is two to three inches. The small fruit bats (*Macroglossus* and allies) of this long-tongued group feed on the juices of soft fruits and on the nectar of flowers.

Insectivorous Bats. Suborder Microchiroptera

The insect-eating bats are usually of small size, although in a few kinds the length of the head and body reaches five and one-fourth inches and the wing-spread may be about thirty inches. With the exception of the false vampire of Australia, the insectivorous bats of the Pacific islands are small. The cheek-teeth have sharp cusps, arranged in W-patterns when viewed from above, and these teeth are squarish rather than oblong. The index finger has never more than two joints and has no claw; in all except the first family (*Rhinopomidæ*) the index finger is composed of the metacarpal bone only (see fig. 20). The tail is usually about as long as the head and body.

Nine families and more than thirty genera of these bats occur in the region included in this discussion. Many of the genera have so many species that lack of space prevents complete description. The families and well-marked subfamily groups are described beyond. Genera are listed in the index.

Mouse-tailed Bats. Family Rhinopomidæ

A single species of these long-tailed bats (*Rhinopoma*) occurs on Sumatra. Relatives live in Egypt and India. They spend the days often in colonies, in caves, old ruins, or large houses. The head and body are about three inches, the tail about two and one-half inches, and the forearm about two and five-eighths inches long. The interfemoral membrane is very short in contrast to the long mouse-like tail, which extends far beyond the membrane. The muzzle has a fleshy nose-leaf and the rather large ears, which reach almost to the nose-leaf when laid forward, are united across the forehead. The index finger has two bony joints in addition to the metacarpal, a unique condition among insectivorous bats.

Sheath-tailed Bats. Family Emballonuridæ

In this family (*Emballonura, Taphozous,* and *Saccolaimus*) the tail projects through the upperside of the interfemoral membrane and ends free. The wing folds in a peculiar manner: the first joint of the third finger folds back on the upperside of the metacarpal (most insectivorous bats have the first joint of the third finger extended in line with the metacarpal when the wing is folded). The nostrils project in front of the mouth, giving the face a sharp angular profile. No member of this group has a nose-leaf. A pouch is frequently present beneath the throat in *Saccolaimus.*

Most sheath-tailed bats are cave or crevice dwellers, often found in old buildings, but some species in the Indies spend the day in hollow trees. They sometimes feed on fruit in addition to the usual insect diet. Bats of this family vary in size from small to medium; head and body are from one and one-half to three and one-half inches, tail from one-half to one and three-eighths inches, and forearm from one and one-fourth to three and one-fourth inches. They are found in the tropical parts

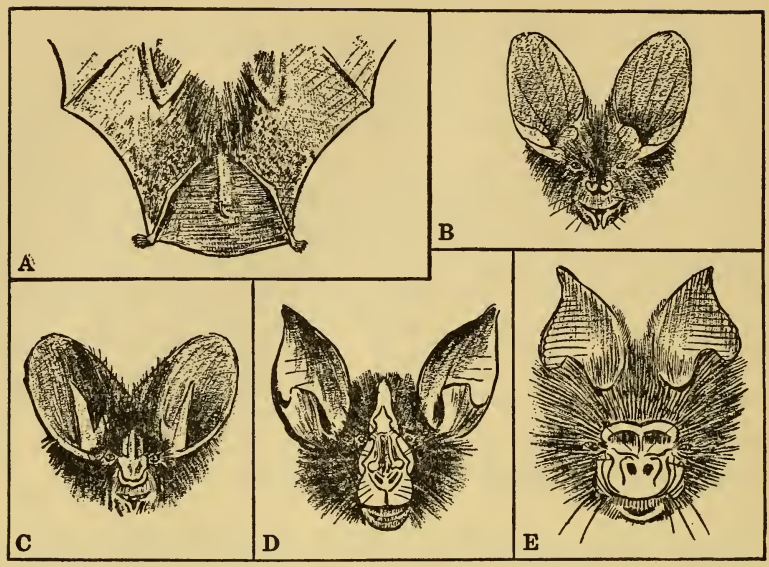

Fig. 24—A. *Tail of Sheath-tailed bat; top view;* B. *Head of Slit-faced Bat;* C. *Head of False Vampire Bat;* D. *Head of Horseshoe Bat;* E. *Head of Leaf-nosed Bat*

of both hemispheres; they extend east to Samoa and Australia, but are not found in New Zealand.

Slit- or Hollow-faced Bats. Family Nycteridæ

A species of the sole genus (*Nycteris*) occurs on Borneo, Java, and east to Celebes and Timor; the other species are African. They are characterized by a long tail, included in the interfemoral membrane to the tip; large ears, longer than the head; the slit down the front of the face, the edges of which are swollen and into which the nostrils open; and wings which are large for the size of the body. The length of the head and body is about two and one-half inches; the tail is slightly longer than this, while the forearm measures approximately one and three-fourths inches.

False Vampire Bat. Family Megadermidæ

One genus (*Megaderma*) extends from the Malay Peninsula to Java and Borneo, while another (*Macroderma*) is Australian. Related bats occur in eastern Africa. These bats have no external tail. The ears are much longer than the head and are united by a fold over the forehead. A large nose-leaf is developed. The false vampires feed chiefly on smaller bats, rodents, frogs, fish, and insects. In the Malaysian species the head and body are about three and one-half inches long and the forearm two and one-half inches. *Macroderma*, the very large Australian false vampire, is colored pale gray, almost whitish. The head and body length reaches five and one-half inches, and the forearm four and three-eighths. It is the largest insectivorous bat of the Pacific region.

Horseshoe Bats. Family Rhinolophidæ

The many kinds of horseshoe bats are members of a single genus (*Rhinolophus*). They are found throughout most of the Old World, north to Japan and east to Australia and New Guinea. The species range in size from small to medium. The head and body are from one and one-half to three and one-half inches long, the tail three-fourths to two and one-fourth inches, shorter than the extended hind leg, the forearm one and one-half to two and seven-eighths inches. All have a complex nose-leaf, broad and horseshoe-shaped below but ending above in a point. The ears are large, pointed, and somewhat concave on the outer border below the tip. The wings fold only slightly when the bat is resting; they cover most of the body like a cloak.

Leaf-nosed Bats. Family Hipposideridæ

The Leaf-nosed Bats (*Hipposideros, Anthops, Cœlops*) are closely related to the horseshoe bats. They differ by the shape

of the nose-leaf and by the fact that their toes have only two joints beyond the metatarsal—the claw-bearing joint and a single intermediate one. Other Old World bats have three joints in all toes except the first. The nose-leaf is squarish, rounded, or ends above in three points. Few members of this family reach large size: the head and body measure from one and three-fourths to three and one-half inches, the tail from three-fourths to two and three-eighths inches, the forearm from one and three-eighths to three and one-half inches. The family ranges throughout the warmer regions of the Old World, east to Australia and the Solomons, and north to the Luchu Islands. *Anthops* of the Solomons has a nose-leaf like a rosette, covering the face from eye to eye, at the top of which are three dome-like structures, their apexes directed forward. It is a rare species.

Typical Bats. Family Vespertilionidæ

This large family, containing about half of the species of insectivorous bats in the Pacific region, is difficult to define. The muzzle is simple except in the Murininæ which have the nostrils produced into tubes and in the Nyctophilinæ which have a small nose-leaf (see below, pp. 59, 60). The ears, arising from the sides of the head, are separate in all species except in the Nyctophilinæ. The third finger has only two bony joints beyond the metacarpal and the tail either ends at the posterior edge of the interfemoral membrane or has one vertebral joint projecting beyond it. The one or two incisors on each side of the upper jaw, are widely separated by a gap, the distance between the medial incisors being usually greater than the distance from these teeth to the canines. The Vespertilionidæ is the most widely distributed family as well as the largest, being found throughout the world, except for a few mid-Pacific islands and beyond the limits of tree-growth. Five subfamily groups are present in the Pacific and Malayan islands and are distinguished below.

Common Bats. Subfamily Vespertilioninæ

Fifteen genera and groups of common bats are present in this area. This extremely large and varied group is almost world-wide in distribution; in the Pacific region these bats are found from the Malay Peninsula north to the Kuriles, east to the Samoan Islands, and south to Tasmania and New Zealand. Representatives of an American offshoot of this group occur on the Hawaiian and Galapagos Islands. The wings are normal, the third finger with the proximal joint more than half the length of the end joints. The muzzle has no nose-leaf, nor are the nostrils produced into tubes. The ears arise from the sides of the head and are neither funnel-shaped nor united across the forehead. There are three lower incisors.

The Mouse-eared Bats (*Myotis*) are the most widespread of the insectivorous group, being found on all continents and adjacent islands as far as the limits of tree-growth, and on the Malaysian and Pacific islands east to Samoa. All of the many species have six cheek-teeth above and below. Most are about the size of the American little brown bats, with head and body about two and one-fourth inches long, the tail a little shorter than this, and the forearm from one and one-eighth to one and one-half inches. Several larger species (forearm about two inches) occur in Sumatra, Java, Celebes, the Philippines, Formosa, and the Luchus. Some of the larger species of *Myotis* are brightly colored, with reddish or orange and black wings, like the butterfly-like *Kerivoula*-bats (p. 61).

The Long-eared Bat (*Plecotus*), found in Japan as well as in continental Asia and Europe, is closely related to the long-eared, jackass, or lump-nosed bats (*Corynorhinus*) of southern and western United States. The long ears may be folded up when the bats are resting. Four cheek-teeth are found above and six below. The head and body of the Japanese form measures about two inches long, the forearm one and one-half inches, the wing-spread about ten inches.

The Pipistrelles (*Pipistrellus*) occurring in Eurasia, Africa, and North America are almost as widely dispersed as the mouse-eared bats. In the Malay and Pacific areas they are found from the Asiatic continent east to the Solomons and south to Tasmania. They are about the size of *Myotis* or even smaller, the length of the head and body varying from one and three-eighths to two and three-eighths inches, and the forearm from one to two inches. Several closely related bats, found from Sumatra to Borneo and the Moluccas, have enlarged sucker-like pads at the base of the thumb. These are often considered to belong to a distinct genus (*Glischropus*), but actually differ little from the small pipistrelles.

The Noctule (*Nyctalus*), a yellowish brown bat with short, broad ears, is found in the Malaysian islands and also in Japan. It is much like a large pipistrelle, with cheek-teeth five in number above and below. The length of head and body is about three inches, and the forearm measures two inches or a little more. Another Japanese species of this genus, otherwise very similar, is about a fifth larger.

The Australian Little Brown Bats (*Eptesicus*) are relatives of the American big brown bat and the European serotine. They are as small as the smaller pipistrelles: the head and body about one and five-eighths inches and the forearm one and one-eighth to one and one-half inches. The cheek-teeth number four above and five below on each side. This genus is represented by a species on the Malay Peninsula, as well as in Australia, but it is not known from the islands.

The Particolored Bat (*Vespertilio*), which occurs in Japan and Eurasia, is reddish brown above; the whitish tips of the hairs produce a marbled appearance. Below it is cream-colored. It is about the size of the American big brown bat: head and body about three inches, forearm about one and five-eighths inches.

The New Guinea Brown Bat (*Philetor*) is dark chestnut-brown both above and below, and has black wing membranes.

Its muzzle is broad and swollen. The cheek-teeth, four above and five below, are the same in number as in *Eptesicus* and *Vespertilio*, and the canine has a small cusp near its posterior base. This bat is found among the mountains of New Guinea. It is intermediate in size between the last two kinds of bats, the head and body about two and one-fourth inches, the tail one and one-half inches, and the forearm about one and three-eighths inches.

The Sarawak Brown Bat (*Hesperoptenus*), light brown in color, is hardly to be distinguished from *Eptesicus* except that its inner incisor is two-pointed and the outer one is minute, hardly visible above the gum. Only one specimen has ever been found. It was collected many years ago in northwestern Borneo. The head and body are two inches long, the tail about one and one-half inches, and the forearm one and three-eighths inches.

The Club-footed or Flat-headed Bat (*Tylonycteris*) is found in the Indian and Malay subregions from the mainland to the Philippines, Celebes, and Timor. It has short wings and a flattened head. The wrist and foot bear thickened pads, apparently adhesive in function. Bats of this genus usually rest during the day in bamboo stems, crawling into them through narrow cracks. These bats include the smallest of the order. The head and body varies from one and three-eighths to one and seven-eighths inches, the tail from one to one and one-half inches, and the forearm seven-eighths of an inch to one and one-eighth inches.

Broad-nosed Bats (*Scoteinus*) are found in Africa, continental Asia, Australia, and New Guinea, but apparently this genus does not occur on the Malaysian islands. The different species are usually colored a uniform brown; some have pale undersides. They have a single conical upper incisor on each side. The cheek-teeth are four above, five below. The skull is broad, more nearly square in outline, viewed from above, than in related bats. The head and body lengths of the different

species vary from one and three-fourths inches to two and three-fourths inches; the tail is about two-thirds as long as the head and body, while the forearm measures one and one-eighth to two and one-fourth inches.

Malay Brown Bats (*Scotophilus*) are found in the islands from the Malay Peninsula and Formosa to Celebes. Closely related forms are found in Africa and on the Asiatic continent. These bats have a short face, a single conical upper incisor on each side, and massive, crowded cheek-teeth. The color is usually yellowish brown, duller below, with black membranes, but reddish individuals are known from Java. These brown bats are medium to large: the head and body two and one-half to three and one-half inches, the tail two to two and one-half inches, and the forearm from two to two and three-fourths inches.

The Barbastelle (*Barbastella*) is dark, almost black, grizzled with yellowish. The large ears are united above the eyes and their lower margins extend on the upper lip, so that the eyes are almost surrounded by the ear shell. The number of cheek-teeth is five above and below. Barbastelle bats are found in the northern Old World region and reach as far east as Japan. They come out early in the evening to feed, often when it is still quite light, and fly slowly and erratically, frequently almost brushing the face of an observer. They are solitary in habit, hiding during the day under the thatch of cottages, in rock crevices, or in holes in trees. The head and body length is about two inches and the tail about the same, while the forearm is from one and three-eighths to one and one-half inches.

Lobe-lipped or Wattled Bats (*Chalinolobus*) are found in Australia, New Guinea, New Caledonia, Norfolk Island, and New Zealand. There are several species, some of which are brown, others gray-brown, others nearly black. The underparts are paler. They are small or medium-sized bats, with the head and body one and three-fourths to two and one-half

inches long, the tail one and one-fourth to two and one-fourth inches, and the forearm one and one-fourth to one and three-fourths inches.

The Galapagos Red Bat and **the Hawaiian Hoary Bat** belong to the same genus (*Lasiurus*), elsewhere restricted to North and South America. They are characterized by a hairy interfemoral membrane and short broad ears. The mainland species migrate long distances, often across considerable bodies of water. Thus they are bats that may readily be carried by storms far from their usual ranges. Even so, the ancestors of the Hawaiian hoary bat must have traveled twenty-four hundred miles from the North American coast, without chance to rest or secure food on the way—a remarkable record of endurance.

Bent-winged or Long-fingered Bats. Subfamily Miniopterinæ

Bent-winged Bats (*Miniopterus*), confined to a single genus, are found in Africa, southern Europe, and Asia, extending north to Japan and east to Australia and the Loyalty Islands. The first joint of the third finger is only about one-third as long as the distal joint, and this last joint is bent under and back against the undersurface of the metacarpal in repose. The crown of the head is high and dome-like. There are five cheek-teeth in each upper jaw, counting from behind the canine, and six in the lower jaw. Most species, though small, have large wings: the head and body measure from one and three-fourths to two and one-half inches. The tail is about equal to the head and body length, and the forearm varies from one and three-eighths to two and one-eighth inches.

Tube-nosed Insectivorous Bats. Subfamily Murininæ

Tube-nosed Insectivorous Bats (*Murina, Harpiocephalus*) have the nostrils drawn out into tubes, much as in certain fruit

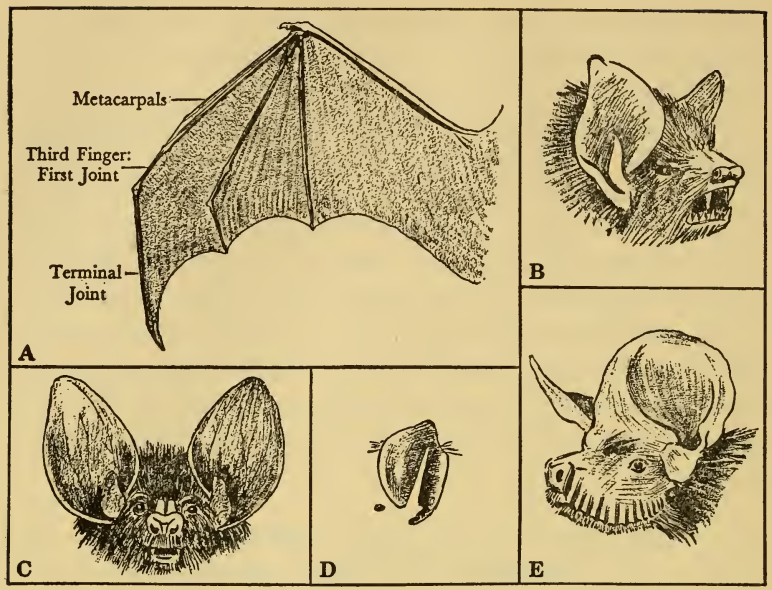

Fig. 25—A. *Wing of Bent-winged Bat;* B. *Head of Tube-nosed Insectivorous Bat;* C. *Head of Australian Long-eared Bat;* D. *Ear of Trumpet-eared Bat;* E. *Head of Mastiff Bat*

bats (*Nyctimene,* see p. 49). The proportions of the third finger are normal, but the thumb is relatively long and the wings are broad. Bats of this group are found from southern Asia east as far as Ceram and north to Japan. Most species are medium-sized: head and body from two to two and one-half inches, tail from one and three-eighths to two inches, forearm from one and one-fourth to two inches.

Australian Long-eared Bats. Subfamily Nyctophilinæ

The Australian Big-eared Bats (*Nyctophilus, Pharotis*) are the only members of the family Vespertilionidæ which combine long ears, approximately an inch in length in most species, united by a fold above the forehead, with a low, horseshoe-

shaped nose-leaf above the truncate muzzle. The head and body length measures from one and three-fourths to three inches, the tail from one and three-eighths to one and three-fourths inches, and the forearm from one and three-eighths to one and seven-eighths inches. Both genera are found in New Guinea. *Nyctophilus* occurs also in Timor and Australia.

Trumpet-eared or Forest Bats. Subfamily Kerivoulinæ

The Trumpet-eared Bats (*Kerivoula, Phoniscus, Anamygdon*) are present in Africa, southern Asia, and throughout the Pacific region west of the Solomons. *Anamygdon* is known only from the Solomon Islands. The long ears are funnel-shaped; the outer margin arises from the side of the head slightly in front of the inner margin and the lower part of the ear is wide. The muzzle is simple. The crown of the head rises high, as in *Miniopterus*. Each jaw, above and below, contains six cheek-teeth. Most trumpet-eared bats are small, the head and body measuring from one and one-fourth to two and one-fourth inches, the tail about the same length as head and body, and the forearm from one to one and three-fourths inches. Most kinds are brown. Some with the body cinnamon-colored and the wings black, handsomely marked with brownish yellow, look like big butterflies.

The New Zealand Bat. Family Mystacopidæ

The New Zealand Bat (*Mystacops*) is the only representative of its family. The third joint of the third finger is bony rather than cartilaginous, as in other insectivorous bats. The tail perforates the interfemoral membrane, much as in the Emballonuridæ (see p. 51). The claws of the thumb and toes are long; each has a small talon at the base. The first joint of the third finger folds inward and forward when the bat is resting. The length of head and body is about two and one-

half inches, of the tail about three-fourths of an inch, and of the forearm one and three-fourths inches.

Free-tailed Bats. Family Molossidæ

The Free-tailed, Wrinkled-lipped or **Mastiff Bats** (*Cheiromeles, Tadarida,* and allies) are partly described by their common names. The upper lip which projects over the lower lip is large and wrinkled while the muzzle is obliquely truncate, all of which gives these bats the look of a mastiff. The tail projects far beyond the interfemoral membrane, which can be moved back and forth on the tail bones, somewhat like an awning, to increase or decrease its extent. The wing is narrow; the entire fifth finger is little longer than the metacarpal of the third. The lower leg is short, the hind foot stout, its toes fringed with long hairs. The family occurs in the warmer parts of both hemispheres.

The Naked Bat (*Cheiromeles*) is one of the ugliest and strangest-appearing mammals in existence. Its snout is long and pig-like, and it has small, widely separated ears. The skin of its neck falls in sparsely haired folds. The rest of the body is covered with hair so short that it looks naked. A glandular pouch is situated on the throat, and under each wing is a large pocket which perhaps serves to carry the young. The hind foot is hand-like, with the first toe large and opposable. This bat is larger or at least heavier than other East Indian insectivorous bats. The head and body reach five inches or more, the tail about two inches, and the forearm two and three-fourths to three and three-eighths inches. It is restricted to the Malayan region: Sumatra, Java, Borneo, and Palawan.

The Big-eared Mastiff Bat (*Otomops*) occurs in Java. It is nearly as large as the naked bat, and is brown. The ears are long, united over the forehead. Another species of this bat is found in Africa.

Other mastiff bats also, with the ears united across the head, are found north to Formosa and east to Norfolk Island, which

lies halfway between Australia and New Zealand. In these the head and body varies from two to three and one-half inches, the tail from one to one and three-fourths inches, the forearm from one and one-fourth to two and one-fourth inches.

Apes, Monkeys, Lemurs. Order Primates

The primates, to which order man belongs, include the apes, monkeys, and lemurs. Their freely rotating forearm and opposable thumb and first toe adapt them for life in trees. The fingers and toes usually have flattened nails. All East Indian primates are ape-like or monkey-like, except two lemurs, the slow loris, and the tarsier. Their illustrations will aid in identification.

The Orang-utan. Family Pongidæ

The Orang-utan (*Pongo pygmæus*) is unmistakable because of its large size and long brick-red hair. It is found only on Borneo and Sumatra. Orangs are heavily built animals with long arms, thick neck, and a melancholy expression on their faces. Their movements are slow and deliberate, and they spend most of their time among the branches of the trees. As they grow older, the males, which are larger than the females, develop large skin-covered callouses on the sides of their faces, which give the face a rounded, dish-like appearance. These callouses are wanting in females. The ears are small, the lips broad, and the chin receding. A male orang-utan may reach four and one-half feet in height and weigh one hundred and fifty pounds. The Sumatran orang-utan is generally more purplish red and not so rusty red as the Bornean. Sumatran males sometimes develop a large mustache. They may represent distinct forms.

Orang-utans construct nests of branches and leaves in which they spend the night. Their food consists of fruit, leaves, and shoots. They are frequently found in the forest-covered swamp-

Fig. 26—*Orang-utan*

lands and along rivers. They are called "mias" by the Dyaks of Borneo and "mawas" by the Malays.

The Gibbons. Family Hylobatidæ

The gibbons are the smallest of the anthropoid apes. Like all the primates of this group they are tailless. They have extremely long arms by which they travel, swinging themselves from limb to limb through the forest. They are noted for their powerful voices, characteristic sounds in the country which they inhabit.

The Siamang (*Hylobates syndactylus*), the largest of the gibbons, is found in the Malay States and Sumatra. An adult standing upright measures over three feet in height. The hair is long and black. The hair on the siamang's forearm dif-

fers from that of other gibbons in being directed upward toward the elbow. Other peculiarities of the siamang include the web of skin between the second and middle toe, extending to the

Fig. 27—*White-handed Gibbon*

first joint, and a large pouch of skin on the neck and throat which can be inflated.

The Dwarf Gibbon (*Hylobates klossi*), the smallest of the gibbons, is black. The head and body length of an adult specimen measures about eighteen inches. This small gibbon

is found only on the islands of North and South Pagi, Sipora, and Siberut, West Sumatra.

The White-handed Gibbon (*Hylobates lar*), found from lower Burma and Cambodia to Sumatra, has a black and a pale color phase, irrespective of sex. It differs from the other gibbons in the fact that the hands and feet are of a lighter color than the arms and legs. The black phase is sometimes grizzled behind the shoulders and its black face is framed with a ring of white hairs which varies considerably in width. Although the light phase may range in color from dark brown to very light buff, the white hairs about the face and the contrastingly lighter hands and feet are always noticeable.

The Agile or Dark-handed Gibbon (*Hylobates agilis*), although the same size as the white-handed gibbon, differs from that animal in having the hands and feet the same color as the arms and legs. Color phases exist in this gibbon also. In the black phase the back is apt to be brown. The white line encircling the face is more variable in this gibbon, in some specimens spreading to the throat and cheeks and in others reduced to a white band on the brow. The pale phase of the agile gibbon resembles that of the white-handed gibbon in all but the hands and feet, which are dark. The agile gibbon is found in the Malay States and Sumatra.

The Gray Gibbon (*Hylobates moloch*) of Java and Borneo is distinguished from both of the preceding by the fact that the color of all individuals is uniformly gray, and there are no color phases. The color is usually ashy gray—in some specimens brownish gray—paler on the back and rump, with a dark patch on the top of the head. The gray gibbon of Borneo has been divided into a number of local races. These are browner than the Javan form and their underparts are darker than the back. Some specimens may have the underparts blackish.

Macaques, Baboons, Guenons. Family Cercopithecidæ

This family includes, besides the macaques, the African baboons and guenons. The macaques are generally rather heavy-bodied monkeys with short, stout limbs, and tail generally shorter than the length of head and body. They have cheek pouches in which food is temporarily stored. The eyebrow ridges are heavy and the canine teeth in the male are long and sharp.

The Japanese Macaque (*Macaca fuscata*) is a short-tailed, long-haired monkey about two feet in length. Its color is dark brown or yellowish brown, darkest along the middle of the back, the hairs annulated with yellow and brown or black and brown. The sides of body and the underparts are grayer. The face in life is bright red. This monkey is found only in Japan.

The Pig-tailed Macaque (*Macaca nemestrina*) ranges from upper Burma to Sumatra and Borneo. The males, with head and body measurement up to two feet, become much larger than the females. The face is flesh-colored. The fur is olive-brown, the hairs being ringed with black and yellow bars. The crown of the head is brownish black, this color often extending along the middle of the back to the base of the tail. The underparts are grayish white. The short tail, about eight inches long, is thinly haired and is carried in an arch.

These monkeys go about in troops and generally live in forested areas. They are often kept as pets and are sometimes trained to climb coconut trees and drop the ripe nuts to their masters waiting below. Old males are inclined to become savage in captivity. The pig-tailed macaque is found on Sumatra, Borneo, Banka, and the Pagi Islands.

The Long-tailed or Crab-eating Macaque (*Macaca irus*) has a very wide distribution, from lower Burma and the Philippines south to Sumatra and east to Timor. It is the only kind of monkey found on many of the islands, and it has been in-

troduced on other islands. On account of its extensive range and isolation on many of these islands, numerous forms have developed and been described. These differ from one another chiefly in size and color. The crab-eating macaque has the longest tail of those discussed—almost as long as the length of the head and body. This monkey, like all macaques, has cheek pouches into which it stuffs food to be eaten later at leisure. The color is variable, generally grayish brown to golden brown, with underparts lighter, the hair being dark at the roots. Individual hairs are ringed with yellow, brown, or black. The face is generally brown, the eyelids bluish white, the hands, feet, and ears black. The hair of the crown is directed backward; it occasionally forms a slight crest or whorl, less prominent than in the macaques of southern India. The measurement of head and body of large males may reach two feet, of the tail about eighteen inches. Females are smaller.

The crab-eating macaques are commonly found among mangroves near the shore and seek their food along the tidal flats at ebb-tide. As the name implies, they are fond of crustaceans. They swim well and often visit small islands offshore.

The Formosan Rock Macaque (*Macaca cyclopsis*) is the only monkey found on Formosa. It is related to the rhesus macaque of southern China, Burma, and India, although it lacks the reddish tone of that animal. Its color is olive-gray or slaty, the hairs finely flecked with yellow, with darker legs and a black line along the top of the tail. The head and body length is about eighteen inches; the tail about ten. These monkeys live among the rocks along the coast; they appear to be rarer in the inland forest.

The Celebes or Moor Macaque (*Macaca maura*) is a large heavy-set macaque with a very short tail. The color is brownish black but some specimens are lighter. The face is black, and the lower parts, rump, and lower legs gray. The total length is about twenty-two inches, and the tail about one inch. On the Eastern Peninsula near Tonkean, a form has been described

which has the legs as dark as the upperparts. The Celebes Macaque from the southern part of the island differs from the one from the north in that the feet are gray instead of black.

The Black or Celebes Ape (*Cynopithecus niger*) may be recognized easily by its elongated face, protruding eyebrows, black color, long hair on the crown of the head, and rudimentary tail. In young specimens the hair is brown. The black ape is found in northern Celebes and on some of the nearby islands. It is a woodland animal, spending much of its time in the trees, but it often seeks its food on the open grassy land adjacent to the forest.

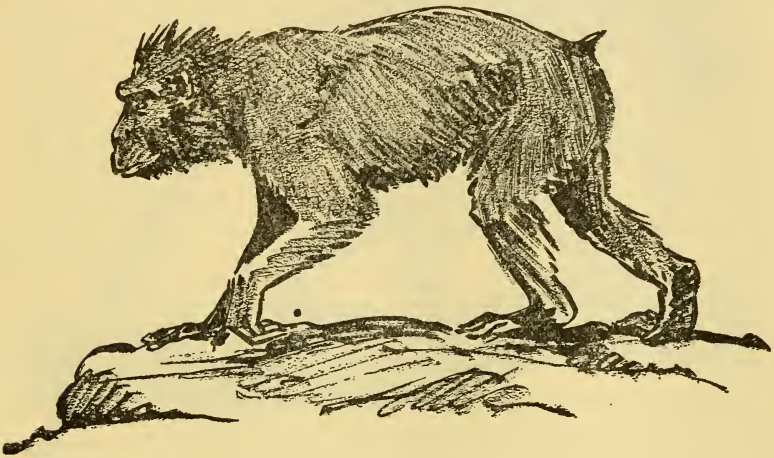

Fig. 28—*Celebes Ape*

Leaf Monkeys or Langurs. Family Colobidæ

This family includes the leaf monkeys or langurs, the proboscis monkey and the stub-nosed monkeys of Asia, and the colobus monkeys of Africa. They feed chiefly on foliage and fruits. Their stomachs are adapted for such a diet, for they are large and sacculated.

The Leaf Monkeys (*Presbytis*) are characterized by their long, narrow hands and feet, with short thumb and first toe, by absence of cheek pouches, and by long tail and limbs. They spend most of their time in the high forest trees where they feed on foliage, flowers, fruit, and seeds. Occasionally they eat insects, birds, and eggs. Although they are able to run with a considerable speed on the ground, they are more at home

Fig. 29—*Thomas's Leaf Monkey*

among the branches. In the trees they travel with great speed, making great leaps, their long tails maintaining their balance and their long hands and feet giving them remarkable grasping powers. Leaf monkeys are found from China, India, and Burma to Sumatra, Borneo, Java, and Bali.

The leaf monkeys vary greatly in color. Some are very handsome animals. The colors of the East Indian forms range through black, brown, red, gray, and white. More than thirty of the many species and subspecies occur. These numerous

forms have been divided into nine groups which differ from one another chiefly in skull characters. Externally they are also characterized by the direction of the hair on the crown and sides of the head. The nine groups are: *femoralis*, *chrysomelas*, *melalopha*, *thomasi*, *aygula*, *hosei*, *rubicunda*, *frontata*, and *pyrrhus*.

In the *femoralis* group, the hair on the crown rises to a high thick crest. A whorl of hair appears about an inch behind the brows and a fringe of hairs above the brows. There are only three races of this leaf monkey found within our limits, two of which occur on the Rhio Archipelago and one in the Natuna Islands. These monkeys are all light brown above, with the outersides of the thighs grayish and the entire underparts white. A white patch shows on the temple behind the eye. In the race found on Bintang Island (*rhionis*) the bases of the hairs on the forehead and crown are brown, while in the animal inhabiting Kundur Island (*canus*) the same hairs have gray bases. The race on the Natuna Islands (*natunæ*) is darker brown above, with blacker limbs and a smaller white patch on the temple, surrounded by black.

In Borneo, the *chrysomelas* group occurs. It is distinguished by a pair of whorls on the forehead with crest similar to the *femoralis* group, and by the lack of the fringe over the eyes. In typical *chrysomelas* of Sarawak the color is similar to that of *femoralis* but blacker, and the lower side of the tail is white for the greater part of its length. From the vicinity of the Miri River yet a second form (*crucifer*) is known. This animal is black and red: the crown, flanks, and outer surfaces of the legs are red, while a black band extends from the nape along the back and down the arms. This may be a color variety of *chrysomelas*.

The third group of the leaf monkeys, *melalopha*, is characterized by the absence of a fringe over the eyes and by the presence of a definite whorl of hairs on the forehead. The hairs grow mainly backward from the brow to form a crest on the crown. The *melalopha* group is restricted to Sumatra and the Batu

Islands, and includes a number of forms, several of which are probably only color phases. The group may be divided into two subgroups, monkeys with blackish backs and monkeys with reddish backs.

Typical *melalopha* is one of the reddish forms. The back is red, slightly tinged with brown. The cheeks and forehead are white, and there is a reddish fuscus band from the side of the brow to the crest. The arms and legs are yellowish red, the hands and feet whitish yellow. The underparts, the inside of the limbs, and the basal half of the tail are white. This monkey is found in the Sumatran mountains opposite Bencoolen south to Mt. Dempo. In the mountains north of the range of *melalopha*, another form of this red monkey is found (*flavimana*). It differs from the preceding by having the forehead red instead of white and the back red, mixed with black. About Indrapura there is found a monkey (*nobilis*) with a deep red back and with cheeks, underside, and inside of the limbs tinted pale red.

At Mt. Ophir a race (*sumatrana*) is found with dark gray-brown on the back and the upperside of the tail. The external parts of the limbs are darker than those of typical *melalopha*, and the hands and feet are black. The lower chest is dusky gray; the chin, throat, belly, and the innersides of arms and legs and basal three-fourths of the tail are white. On the Batu Islands a smaller form (*batuana*) is very similar in color to *sumatrana*. In the Siak district on the eastern side of Sumatra, the leaf monkeys (*percura*) of this group have tails grizzled instead of pure white.

In the southern part of Sumatra a variable monkey of the *melalopha* group (*fusco-murina*) is distinguished by the absence of any red on the back, on the outerside of the limbs, or upperside of the tail. The back and outsides of the forelegs are brownish gray and there is a dark stripe on the brow and sides of the head. The top of the head is whitish. The naked skin on the face, hands, and feet is white. A white animal with brownish gray back, yet unnamed, is thought by some to be a color variety

of the foregoing. It is found in the highlands of Palembang.

The Mentawi Leaf Monkey (*Presbytis potenziani*) is black with some white on the head. It is restricted to the Mentawi Islands off western Sumatra.

The fourth group contains only the species *thomasi* from northeastern Sumatra. It is dark smoky gray on the back. The upperside of tail, the outersides of limbs, feet, and hands are black; the forehead is white with median and lateral black stripes; the innersides of the limbs and underparts are white. This animal differs from the members of the *melalopha* group in having the short hairs of the cheeks growing forward to form a curved crest between the eye and the ear. There is also a pointed medial crest. It lacks the frontal whorl and the definite brow fringe.

On the island of Java, the gray leaf monkey, *Presbytis aygula*, is found. This animal is dark ashy gray, darker on the loins, with the head, cheeks, and upper basal part of the tail black. The outsides of the limbs are similar in color to the back but there is generally some white on the hands and feet, and the underparts are white. On Mt. Slamat, Java, a closely related form (*fredericæ*) occurs. With the exception of some white on the throat and underparts it is entirely black.

Hose's Leaf Monkey (*Presbytis hosei*) of north central Borneo lacks the frontal whorl, the hairs sweeping backward to form a crest less pronounced than that of *thomasi* of Sumatra. The back and sides, tail and outsides of the limbs are ashy gray. The hands and feet are black. The underparts are white. The underside of the tail is little darker than the upperside. This monkey differs from all of the preceding by the fact that the head markings of the sexes differ. In the male the forehead is wholly covered with a white band which joins the white of the temples and cheeks and then passes over the ear to the sides of the neck, thus leaving but a narrow band of blackish gray along the nape to connect the colored crown and shoulders. The female, in most cases, has the white on the head, cheeks,

and sides of neck less extensive or on the crown and forehead even wanting. On Mt. Kina Balu there is a monkey (*canicrus*) in which both sexes resemble the female of *hosei*, except that the crown and nape are brownish, there is no white spot on the forehead, and the forearm and lower legs are never blackish but gray, strongly contrasting with the black hands and feet. In the flat forest land between Paitan Bay and Sandakan Bay, northeast Borneo, another race (*sabana*) occurs. It is similar to *hosei*, except that the chin, cheek, and temples are black and there is no white on the head, which is grayish black.

The seventh group of leaf monkeys (*Presbytis rubicunda*) of Borneo is distinguished by its golden red or brown color and pale reddish underparts. There is no sharp contrast in color between the inside and outside of the legs as in the case of most leaf monkeys. In typical *rubicunda* from near Bettotan, North Borneo, the feet and hands are black, while in the subspecies *ignita* from Sarawak, the hands and feet are similar to or very little darker than the arms and legs. On Karimata Island southwest of Borneo a supposedly paler monkey (*carimatæ*) is found.

The eighth group (*Presbytis frontata*) of Borneo may be identified by a naked or nearly naked patch on the forehead. Typical *frontata* is dark brown or grayish brown on the back, with black limbs, hands, and feet. The temples, brow fringe, and cheeks in front of the ears are also black. The color of the base of the tail, similar to the back, gradually becomes dark ashy gray at the tip. The underparts are paler than the back. This form is found in southeast Borneo. A subspecies (*nudifrons*) from Bajalong, Sarawak, is said to be grayish brown above and grayer below; there are some white hairs on the sides of the jaw.

The Silvered Leaf Monkey (*Presbytis pyrrhus*) inhabits the mainland, Sumatra, Borneo, Java, Bali, and the Natuna Islands. *P. pyrrhus pyrrhus*, found in eastern Java, is usually black with a varying amount of gray- or buff-tipped hairs. It also has a red phase. The newborn young of this group are

uniform golden red; those of all preceding leaf monkeys are white, generally with a black dorsal band and sometimes with hands, feet, legs, and shoulders black. The western Javan form (*sondaicus*) is a blacker animal, with a few gray-tipped hairs restricted to the back of the thighs. One subspecies (*kohlbruggei*) is confined to the island of Bali. It is similar in color to the Javan form of *pyrrhus*, but it is slightly smaller. In Sumatra, Borneo, and some of the neighboring small islands another form (*cristata*) is distinguished by grayer hair tips and paler ground color. *P. p. ultima* of Sumatra and Borneo is a still paler form. On the South Natuna Islands *vigilans* occurs. Although similar to *cristata* in outward appearance, it is characterized by skull differences.

The Proboscis Monkey (*Nasalis larvatus*) is confined to Borneo. Its color is reddish or yellowish brown above, with yellowish gray on rump, tail, and limbs. The undersurface is yellowish white. In old males the tail is often white. The most striking characteristic of this large monkey is its nose, which in old males is much enlarged and movable. Proboscis monkeys, traveling in small troops, prefer branches over water and are frequently seen in Nipa palm swamps near riverbanks. Those animals from northeast Borneo (*orientalis*) are paler than the typical ones from west Borneo.

The Pig-tailed Langur (*Simias concolor*), a large langur with a short tail, occurs on the Mentawi Islands, off the southwestern coast of Sumatra. This monkey appears blackish brown, although the individual hairs, especially about the shoulders, are ringed with buff. It can be recognized by its short (less than six-inch), nearly naked tail and its short, upturned nose. The typical race was first discovered on South Pagi Island. On Siberut Island a darker race (*siberu*) has been distinguished, of which a creamy buff phase has been recorded.

Fig. 30—*Proboscis Monkey*

Lorises. Family Lorisidæ

This family contains the Asiatic lorises and the African pottos. The slow loris is the only member found in the Malay region.

The Slow Loris (*Nycticebus coucang*) occurs from Assam and Indo-China south through the Malay Peninsula to Sumatra, Borneo, and Java. It is found too on Banka Island, the islands of the Rhio Archipelago, northern Natuna Island, and the

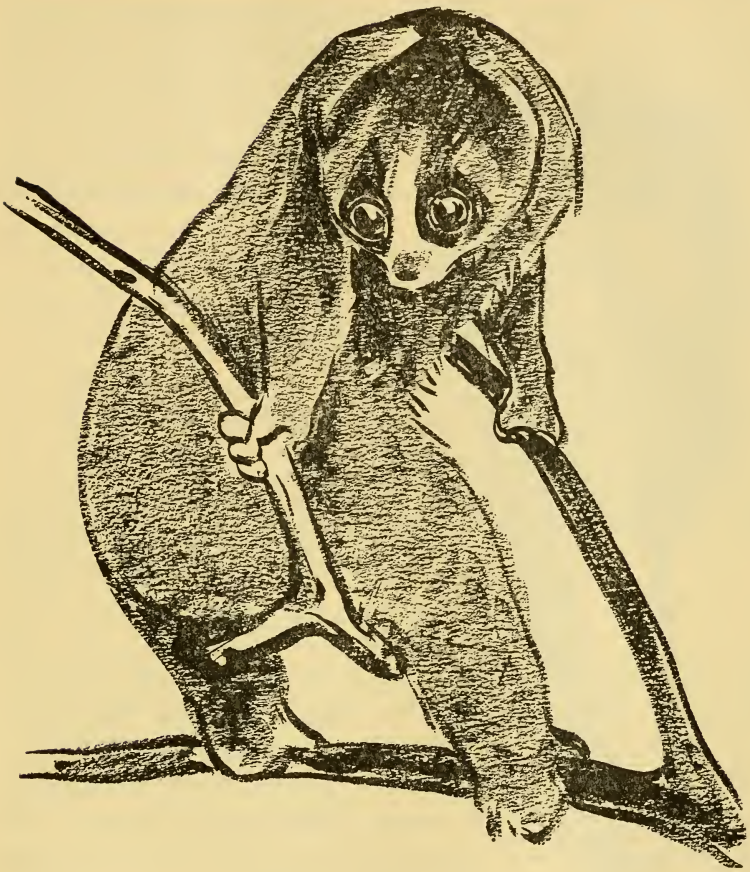

Fig. 31—*Slow Loris*

southern Philippines. It has a short, rounded head, with large eyes set close together, short ears scarcely visible above the fur, short neck and very short tail concealed by body hair. The limbs are short, the fur close and woolly, and the hands and feet designed for grasping. The color is usually silver-gray with a buffy wash, but it varies somewhat in different forms. Dark brown markings generally encircle the eyes. They are seen also on the crown of the head, and often connect with a stripe of

Fig. 32—*Tarsier*

varying length down the back. The total length of the slow loris is from twelve to sixteen inches. This animal is arboreal and nocturnal in habits, seldom descending to the ground. It is very slow and deliberate in its motions. It feeds on insects, fruit, and vegetation.

Tarsiers. Family Tarsiidæ

The Tarsier (*Tarsius*) is distinguished by its rounded head, very short, pointed muzzle, large ears, and large eyes which form the most arresting feature of the face. The hind limbs are long, especially the feet. The fingers and toes end in flattened pads which may be slightly adhesive. The tail is long, nearly naked, ending with a tuft of hair. The thick, woolly fur is brownish yellow, the bases of its hairs slate-gray; underparts are paler. The length of head and body is about six inches, of the tail about ten inches.

Tarsiers are island animals found on Sumatra, Banka,

Billiton, Borneo, the southern Philippines, and Celebes. Throughout this territory their appearance is sufficiently different to lead to the description of a number of species and subspecies. The tarsier is nocturnal, as its large eyes indicate. It lives among brush, trees, and bamboos, and moves by a series of leaps; it can jump long distances.

Flesh-eaters. Order Carnivora

The teeth of carnivores or flesh-eating mammals are generally modified for a flesh diet; the strong prominent canines and cheek-teeth are adapted for rending and cutting rather than grinding food. In certain members of the order which feed chiefly on vegetable matter the molars are broader and are used for crushing. The toes have claws. This order includes the bears, martens, weasels, badgers, otters, dogs, wolves, foxes, civets, mongooses, and cats.

Bears. Family Ursidæ

The bears are large, heavily built carnivores with molar teeth broad, flattened, and suitable for crushing rather than cutting —in contrast to the case of the cat. They have short tails and plantigrade feet; that is to say, they walk on the soles. They are among the least carnivorous of the flesh-eating mammals, for much of their food consists of roots, fruits, and other vegetable matter.

The Eurasian Brown Bear (*Ursus arctos*), which had a very extensive range, is still found in suitable localities in Europe and Asia. On account of this wide distribution the color and size varies to such an extent that this bear has been divided into numerous subspecies. Its color may range from light brown to black. One of the darker forms (*lasiotus*) is found on Hokkaido Island, Japan, the Kurile Islands, and Sakhalin.

The Peninsula Giant Bear (*Ursus gyas*) belongs to the group known as the Alaskan brown bears, closely related to the

grizzly and Eurasian brown bear. The range of these bears includes the islands and mainland of the western coast of Alaska from Unimak Island to British Columbia. The group contains the largest existing carnivorous mammals, rarely attaining a weight of three-fourths of a ton.

The Asiatic Black Bear (*Selenarctos thibetanus*) is distributed from northern China and Manchuria south into the Himalayas, Burma, southern Japan, and Formosa. It corresponds in size to the American black bear but has larger ears, broader body, and is marked on its chest with a large white or creamy inverted chevron. The race found in Japan (*japonicus*) is the smallest of the Asiatic black bears, attaining a length of about four feet. The Formosan subspecies (*formosanus*) is slightly larger—about four and one-half feet long.

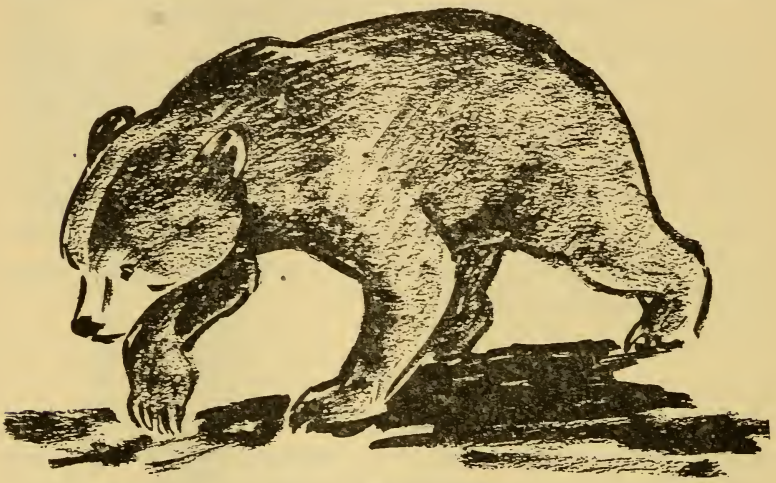

Fig. 33—*Malay Bear*

The Malay Bear (*Helarctos malayanus*) is the smallest of the bears. It occurs in wooded areas from Assam, Burma, and Indo-China south through the Malay Peninsula to Sumatra and Borneo. This bear is commonly black, but the pelage when worn may have a brownish tinge. The breast patch is generally buff

or dirty white and the muzzle gray. The front legs are noticeably bowed, the front paws inturned. A specimen as long as four feet is a large animal. Little has been published about its habits but it is known to be a good climber.

Weasel-like Mammals. Family Mustelidæ

The Yellow-throated Marten (*Martes flavigula*) ranges from China and Amurland southward to Formosa, Sumatra, Banka, Java, and Borneo. Its color is brown, gradually dark-

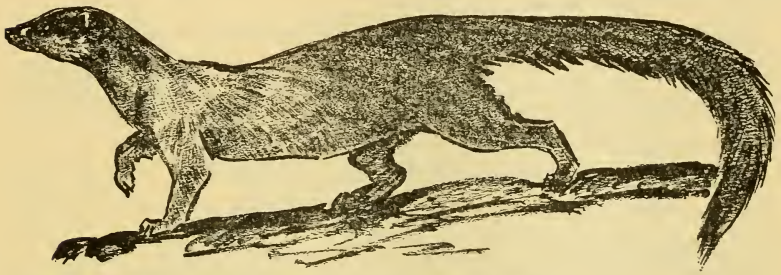

Fig. 34—*Yellow-throated Marten*

ening from light brown on the shoulders to very dark brown or even black on the lower back and tail. As its name signifies, the throat is orange-yellow. This marten has short legs, long body, long tail, and pointed nose, and is about the size of a small cat.

The Japanese Marten (*Martes melampus*) differs in color on the several Japanese islands. On Kuishui Island it is a rich golden brown, while on Hondo and Tsushima the back is much browner. All specimens have a bright orange throat.

The Sable (*Martes zibellina*), also one of the martens, is well known for its valuable fur, which is generally blackish above with gray on the nose and face. Often there is a yellow patch on the throat. It is found in the forests of northern Asia, especially in eastern Siberia and Kamchatka. It has been reported on Sakhalin.

The Ermine or Stoat (*Mustela erminea*) is the large weasel present throughout northern Europe and Asia. In summer this

animal's fur is brown with white underparts, but in winter the coat changes to white. The tip of the tail is always black. The ermine is found in northern Japan and Sakhalin.

The Pygmy Weasel (*Mustela rixosa*) is the smallest of the carnivores. The head and body length is about six inches, the tail about one and one-half inches. Like the ermine, this weasel turns white in winter; the tip of the tail is never black. Pygmy weasels or closely related forms occur in parts of North America, Asia, and Europe. They are found too in the Aleutians, Kurile Islands, and Japan.

The Java Weasel (*Mustela lutreolina*) could be mistaken in size and color for our American mink. Its shorter hair, usual in tropical animals, distinguishes it. Though it is believed to be confined to Java, it may be found in Sumatra as well.

The Bare-footed Weasel (*Mustela nudipes*) of Sumatra and Borneo is about the size of the mink. Its color is pale orange-brown, paler on the head. The tail is rather bushy.

The Oriental Weasel (*Mustela siberica*) is similar to the bare-footed weasel but the soles between the foot pads are hairy. It is found throughout eastern Asia from Siberia to southern China and in Japan and Formosa. The pelts of this weasel, dyed a dark color, are known in the fur trade as Japanese mink and kolinsky.

The wolverine (*Gulo gulo*) is found in the northern districts of North America, Europe, and Asia, including the forests of Sakhalin. Its dark brown fur is marked with two paler stripes which begin at the shoulders and pass along the sides of the body to meet again at the tail. The wolverine is about three and one-half feet long and weighs nearly thirty pounds.

The Eurasian Badger (*Meles meles*) is represented in Japan by a race somewhat darker than the typical European form. Its coat is dark gray. The nose, a stripe down the forehead, the lower face, the ears, throat, and chest are whitish. The badger is about three feet in length, including the tail which is about eight inches long.

The Ferret Badger (*Helictis orientalis*) is about the size of the American skunk. The somewhat bushy tail is about nine inches long. The body hair is brown, with a stripe extending from the top of the head between the shoulders halfway down the back. Markings on the face and cheek are white; the tail also is white. The throat and chin are white with a strong orange tinge. The ferret badgers occur from China and Formosa south to Java and Borneo.

Fig. 35—*Teledu*

The Hog-nosed or Sand Badger (*Arctonyx collaris*) occurs from the eastern Himalayas and China south to Sumatra. Its appearance reminds one of the American badger. However, its body is higher, and its tail and bare snout are longer. The color is dirty gray. The soft underfur contrasts with the long, stiff guard hairs. The lower part of the body is dark, the legs often black. The length of the head and body is about thirty inches and the tail about ten.

The Teledu or Malay Badger (*Mydaus javanensis*) is confined to Sumatra, Java, Borneo, and Bunguran Island. It is comparatively small; the head and body are about fifteen inches long and the short tail scarcely one inch. The long thick fur is dark brown above, lighter below, with a white stripe ex-

tending from the crown along the center of the back. This animal is noted for its skunk-like ability to eject an evil-smelling fluid for a considerable distance.

The Eurasian Otter (*Lutra lutra*) is represented by forms in Japan, Formosa, Sumatra, and Java. The smooth otter (*Lutra perspicillata*) of India, recognized by its shorter, smoother coat, is found also in Sumatra. The hairy-nosed otter (*Lutra sumatrana*) of the Malay States, Sumatra, Banka, and Borneo is distinguished from others by its completely hairy muzzle. The small-clawed otter (*Lutra cinerea*), a much smaller species, ranges from northern India and China to Sumatra, Java, and Borneo.

The Sea Otter (*Enhydra lutris*) is found on the shores of the Pacific Ocean from Southern California north to Alaska and the Aleutians, west to Kamchatka and the northern Kurile Islands. The animal is about four feet long, one foot of which is the tail. The fur is brownish black, many of the guard hairs being tipped with white. The pelt of the sea otter is considered one of the most valuable of furs; a single skin has been sold for as high as twenty-five hundred dollars. On this account, the animal was formerly so much hunted that it was threatened with extinction, but due to enforcement of strict laws protecting it, is again increasing in numbers.

Dogs, Wolves, Foxes. Family Canidæ

The members of the dog family are generally medium-sized animals with long muzzles, non-retractile claws, long legs well adapted for running, strong canines, and molars of shearing-crushing type. Their pelage is usually long and thick. Their habits are terrestrial, and their sense of smell highly developed.

True Wolves occur throughout the unsettled parts of the northern hemisphere. Wolves are ancestral to many of the breeds of domestic dogs.

The Northern Wolf (*Canis lupus*) occurs throughout northern and temperate Europe, Asia, and North America. Various

forms are found in Japan, Sakhalin, the Kurile Islands, and the big Arctic wolf of the Alaskan Peninsula may stray to Unimak Island.

The Dingo or Warrigal (*Canis dingo*), the only wild carnivore found in Australia, is believed to have been brought there by ancestors of the Australian blacks. That the dingo inhabited the country as far back as late Pleistocene (Ice Ages) is proved by the presence of its fossil remains associated with bones of marsupials of that period. The dingo is about the size of a setter dog. Its color is generally tawny, darker on the head and back and lighter beneath. The feet and the tip of the tail are often white. Other color varieties such as black and white animals occur. Dingos have been domesticated and used by the natives in hunting. They cross so readily with other dogs that pure dingos are rare in settled districts.

Wild dingos inhabit both open plains and forests. They hunt singly, in family parties, or occasionally in large packs. Their food consists of the smaller kinds of kangaroos and any other game that they can catch. They are much disliked by sheep herders because they kill sheep. Pure dingos do not bark but emit a series of yapping notes and mournful howls. From five to eight pups generally constitute a litter; they are born in burrows, in crevices among rocks, or in hollow logs.

The Asiatic Wild Dog (*Cuon javanicus*) is reddish, somewhat like an Irish terrier, and is about the size of a small collie. It generally hunts in packs, and may kill animals of considerable size. In Java and Sumatra deer appear to be most often hunted. In India wild dogs have been known to kill buffalo and even are reported to have driven tigers from their dead prey. The Asiatic wild dog ranges from Siberia south through eastern and central Asia to the Malay Peninsula and to the islands of Sumatra and Java.

The Raccoon Dog (*Nyctereutes procyonoides*), a small fox-like animal with short legs and tail, is colored much like the raccoon, even to the dark mask across the eyes. It is found

from Amurland south throughout much of eastern China, and occurs in Japan.

The Red Fox (*Vulpes vulpes*) has much the same range as the wolf. It is better able to withstand civilization, so that it occurs in many places where the wolf has been exterminated. The red fox needs no description, for wherever found it is much the same. Its coat may vary from reddish yellow to a darker reddish and some forms are more grayish. Its black ears and white-tipped tail invariably distinguish it throughout its northern range. In various localities color phases occur, such as the black, silver, and cross varieties. All of these show the white tail tip. Forms of the Old World red fox are found in Japan, Sakhalin, and the Kurile Islands.

The Arctic Fox (*Alopex lagopus*) is circumpolar in distribution. No other land mammals range farther north. Its summer coat is dark brownish slate with whitish underparts, in winter pure white. In certain sections the color of some individuals is bluish drab instead of white. This bluish drab color phase produces the blue fox of the fur industry. The Arctic fox is small; its total length is about thirty inches, and the tail ten inches. It is found on the Aleutian and Kurile Islands.

Civets and Mongooses. Family Viverridæ

The small carnivores composing this family vary in size from foxes to rats. They have long slender bodies, short legs, long pointed heads, and sharp, more or less retractile claws. Most of the civets have musk glands situated under the tail.

The Malay Civet (*Viverra tangalunga*) is about the size of a domestic cat. Its head is long and fox-like. The general color of the fur is dark gray, frequently tinged with yellowish or brownish. The sides and lower surfaces of the neck are banded with distinct black stripes with white or pale interspaces. The bands on the remaining parts of the body are broken up, producing a spotted effect. A mane of long black hairs extends along the top of the back from the shoulders to the basal part

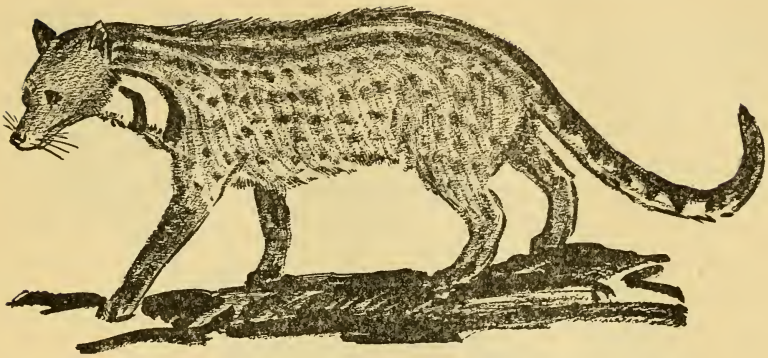

Fig. 36—*Malay Civet*

of the tail. The tail is ringed with black and white or gray, the dark rings connected by a black line along the greater part of the upperside. In some specimens the interspaced light rings are indistinct. The Malay civet, including the foot-long tail, is about three feet long. This small species occurs from the Malay peninsula and the Philippines to Ceram and the Moluccas.

The Asiatic Civet (*Viverra zibetha*) is found from China south throughout southeastern Asia. The civet scent of commerce is obtained from the musk glands of these animals, which are believed in some cases to have been introduced on islands for the sake of the perfume. The civets are terrestrial, frequently making their homes in burrows. They are reputed to be poultry thieves.

The Little Civet (*Viverricula malaccensis*) is about the same size as the Malay civet. Its name is thus misleading in the East Indies, though true in India and Burma. The length of head and body is about twenty-two inches, of the tail fourteen inches. It appears to be a shorter-legged, longer-bodied, longer-tailed, more weasel-like animal than the Malay civet. The color is gray, with brown markings. It lacks the dorsal mane of the Malay civet. Five brown stripes generally extend along the back from behind the shoulders to the base of the tail. Black stripes extend on the throat and along the sides of the body, and along

Fig. 37—*Little Civet*

the sides of the neck are several series of brown spots. The tail, ringed with white, generally has a white tip. The animal is reported to be a good climber. On the continent the range of the little civet is very similar to that of the Asiatic civet, but on the islands it is found only on Sumatra, Java, Kangean Islands, Bali, and Formosa.

The Linsang (*Prionodon linsang*) is characterized by its very long, slender body, its short limbs, elongated neck and head, and the long tail which equals or surpasses the head and body in length. The ground color, although variable, is generally buffy white. The crown and muzzle are brownish and the forehead brownish buff. Five broad transverse bands of

black or dark brown extend across the back successively from behind the shoulders to the tail. The long tail is ringed with this color throughout its entire length. Two dark stripes extend from the forehead along the upper neck to the shoulders, and lesser striping is found on the lower neck. Other streaks and spots appear on the flanks and legs. The head and body are

Fig. 38—*Linsang*

about fifteen inches long, the tail about the same. The linsang is found from upper Burma, through the Malay Peninsula to Sumatra, Banka, Java, and Borneo. The linsang found in Borneo and Java (*gracilis*) is smaller than that of the Malay Peninsula and Sumatra. This animal is equally at home on the ground and in the trees and is said to make an interesting pet.

The Palm Civet (*Paradoxurus*) has well-developed scent glands. Its feet are adapted for climbing. The general shape of the body is long, the legs are short, the tail long and un-

banded except in the Celebes form. The body is marked with a definite pattern of dorsal stripes and lateral spots. The palm civets have a very extensive range, from southern China throughout the forested areas of southeastern Asia to Sumatra, the Philippines and Ceram. A record from the Aru Islands is doubtful. In this great expanse of territory many forms have been distinguished; some islands have their own subspecies. Palm civets of the East Indies, which are considered subspecies of the Indian palm civet (*Paradoxurus hermaphroditus*), differ

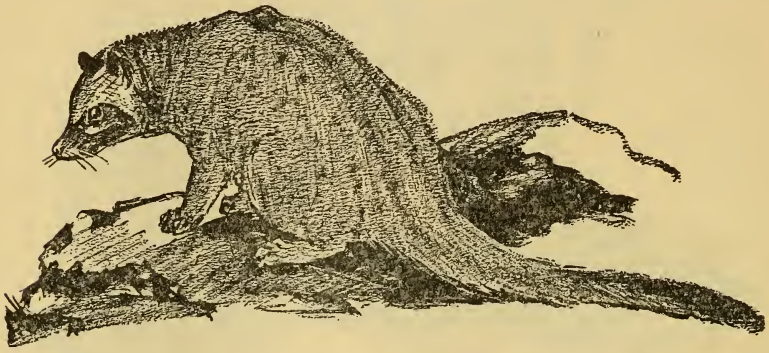

Fig. 39—*Palm Civet*

slightly in color, in the amount of white about the head and cheeks, and in size. They are the size of a cat, but the legs are shorter and the tail longer. The ground color of most of the body is grayish buff, and a narrow black stripe extends down the center of the back with two lines on each side. The black tips of the longer hairs are sometimes so extensive that the pattern is obscured. The lateral lines are often broken up into spots, and the flanks and sides also are more or less spotted. The feet and legs are black, as is the terminal half of the tail.

The Brown Palm Civet (*Macrogalidia musschenbroeki*) of Celebes is quite different from other members of the group. Because of its peculiar skull characters it has been placed in a separate genus. Its color is rufous brown with numerous white hairs intermixed. The white face markings of other palm civets

are absent. The tail has alternate rings of dark and light brown.

The palm civets are chiefly vegetarian. They feed on fruit but also eat small mammals, birds, reptiles, and insects. They are frequently found about villages and spend much of their time in trees.

The Masked Palm Civet (*Paguma larvata*) is distinguished from the true palm civet by the absence of body pattern and

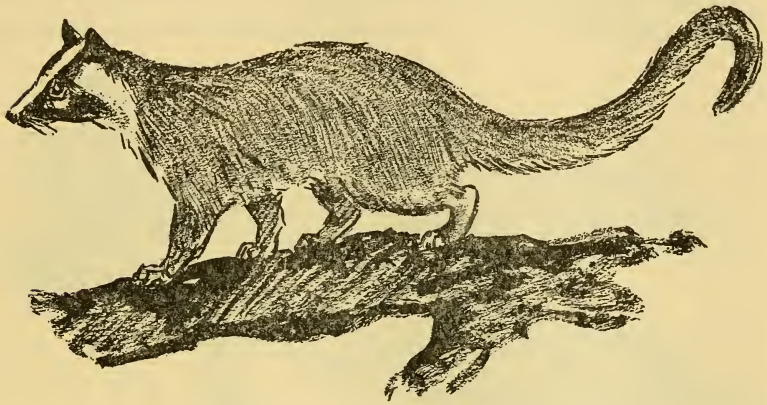

Fig. 40—*Masked Palm Civet*

by skull characters. It is found from Tibet, China, and Formosa south through the Malay Peninsula to Sumatra and Borneo. It is about the size and build of a palm civet. The Sumatran and Bornean subspecies of masked palm civet is brownish buff, the neck and shoulders much darker, even black, the hind back and rump paler. The lower legs and feet are black and the tail darker toward the tip. Buffy white cheek patches extend from behind the ears to the forehead. The habits of this animal are similar to those of the palm civets.

The Binturong or Bear Cat (*Arctictis binturong*) is larger than the palm civets. The head and body attain about fifty-four inches in length, the tail a little less than half that amount. Its color is black or blackish brown but many of the hairs are tipped with a buffy or whitish color, which gives the coat a speckled

appearance. The amount of speckling differs widely; some specimens are almost black, others straw-colored. The head is always more heavily speckled than the body, and the ears are conspicuously tufted. The binturong is chiefly arboreal, and uses its prehensile tail in climbing. It ranges through southeastern Asia and from Sumatra to Borneo, Java, and Palawan.

The Small-toothed Palm Civet (*Arctogalidia trivirgata*) is tawny-colored and has a softer coat than any of the preceding.

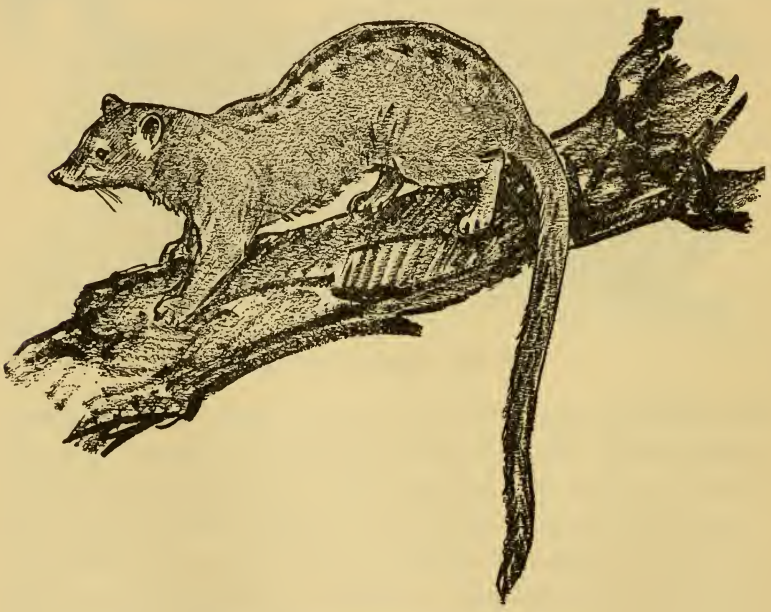

Fig. 41—*Small-toothed Palm Civet*

The head is usually darker and the underparts lighter than the back. A narrow white streak extends from the forehead to the nose. An indistinct dark line runs along the back from the crown to the tail, and in some of the forms two other lines parallel the median line; in some specimens these last lines may be

broken up into spots. This animal is about forty-five inches long, the tail being a little more than half this length. It has arboreal habits, and being chiefly nocturnal, it is seldom seen. The range of the small-toothed palm civet extends from Assam and Burma to Java and Borneo.

The Banded Palm Civet (*Hemigalus derbyanus*) has a characteristic color pattern. The dorsal ground color is dark buff. From the crown to the shoulders are two longitudinal dark bands, replaced on the shoulders by transverse bands. Across the back between the root of the tail and the shoulders are five additional broad transverse bands. The underparts are paler and unbanded. The head and body length is about twenty inches and the tail fifteen inches. The banded palm civet is found from Tenasserim to Sumatra, South Pagi Island, Sipora Island, and Borneo. It appears nowhere to be a common animal, and very little is known of its habits.

Hose's Palm Civet (*Hemigalus hosei*) is a relative of the banded palm civet with which it compares in size. It lacks the dark striping. This animal is uniform dark smoky brown with white spots on each side of the muzzle, over each eye, and on the ears and chin. It is found only in Borneo.

The Otter Civet (*Cynogale bennettii*) externally suggests a short-tailed otter. The thick coat is dark brown, with the tips of many of the hairs gray. The total length is about thirty inches, the tail being about six inches. This rare animal is adapted for aquatic life and is an expert fisherman. It is found in the Malay States, Sumatra, and Borneo.

The mongooses may be distinguished from the civets by their longer, straighter claws, which cannot be retracted, and by lack of scent glands. They are long-bodied, weasel-like animals with bushy tails. They are chiefly terrestrial.

The Short-tailed Mongoose (*Herpestes brachyurus*), which lives in the Malay States, Sumatra, and Borneo, is the largest and darkest of the East Indian mongooses. Its color is dark

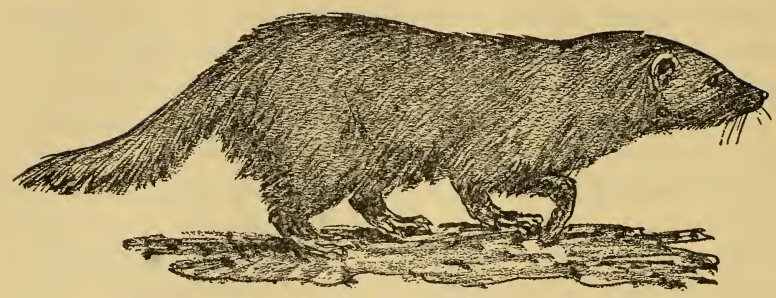

Fig. 42—*Short-tailed Mongoose*

brown or black. Many of the hairs are tipped with buff, especially on the head and tail. The legs are black. The head and body are about twenty inches long and the tail ten inches.

Hose's Mongoose (*Herpestes hosei*) is a smaller and browner animal than the short-tailed mongoose. It is confined to Borneo.

The Collared Mongoose (*Herpestes semitorquatus*) likewise is found only in Borneo. It is a richly colored animal, dark brown with buffy grizzling, and the sides and underparts rufous. A buff-colored stripe extends from the jaw below the ear along the side of the neck. The tail is much lighter in color than the rest of the body. The length of the head and body is about sixteen inches, of the tail about nine inches.

The Javan Mongoose (*Herpestes javanicus*) is the only mongoose on Java. Related forms occur from southern China throughout much of southeastern Asia. The color varies; in some it is dark brown with buffy specklings, in others rich mahogany. The head and body are about seventeen inches long and the tail about twelve inches.

The Crab-eating Mongoose (*Herpestes urva*) is about twenty inches in head and body length, its tail about nine inches. It is black grizzled with buffy and has a white stripe running from the corner of the mouth to the shoulder. The crab-eating mongoose is found from southern China and Formosa to Burma and Tenasserim.

Cats. Family Felidæ

The cats have supple and muscular bodies, rounded heads, and sharp claws which can be retracted into protecting sheaths. The large cheek-teeth are of the shearing type, the canines long.

The Tiger (*Felis tigris*), which with the lion shares the distinction of being the largest of the cats, occurs from Siberia and China through much of southern Asia as far as the islands of Sumatra, Java, and Bali. Various subspecies have been named, and the tigers from Sumatra, Java, and Bali have each been described as different. The Sumatran race (*sumatræ*) is supposed to be smaller than the Bengal tiger, more fully striped, and to have less white on the underparts. The Javan tiger (*sondaica*) differs chiefly in skull characters. The Bali race (*balica*) is still smaller. The markings, colors, and sexes of tigers from the same locality differ so greatly that it is doubtful whether these subspecies are valid. The tiger lives in thick jungle and feeds on deer, pigs, and often the cattle of the natives.

The Leopard or Panther (*Felis pardus*) occurs throughout southern and eastern Asia. South of the Malay Peninsula it is found only in Java and the Kangean Islands. Reports of its occurrence on Sumatra have never been substantiated. After the tiger, the leopard is the largest of the Asiatic cats. It is easily recognized by its large size—head and body from three and one-half to four feet long, tail from two and one-half to three feet in length—and by the character of its spots. Clusters of spots, or rosettes appear on the back and sides, and solid spots on its head, limbs, and belly. The leopard of Java and the Kangean Islands (*melas*) is distinguished by its small size, its short, dark, richly colored coat, and small, close-set rosettes. The black or melanistic form of the leopard is only a color phase of the regular leopard and does not represent a different species, as many believe. Even in the blackest individual the spots are visible in certain lights. The black phase is common

in the Malay Peninsula, where in certain sections it is more abundant than the spotted one. A single litter of cubs may contain both black and spotted individuals.

The Clouded Leopard (*Felis nebulosa*) inhabits the forested areas of southeastern Asia, Formosa, Sumatra, Java, and Borneo. It ranks next in size to the leopard. The head and body of a large male may measure three feet. Its tail is longer than

Fig. 43—*Clouded Leopard*

that of the common leopard, reaching about thirty inches. The color of the hair is grayish brown. The sides are ornamented with large darker grayish patches, often partially edged with black. The patches may be so large and numerous that the lighter background is reduced to a series of narrow bands. The long, well-furred tail and the exceptionally long upper canine teeth are outstanding characters of this animal. The clouded leopard prefers the forests and is more arboreal than most cats.

The Marbled Cat (*Felis marmorata*) has the general markings of a clouded leopard but is little larger than a house cat. Its ears are rounded and its tail somewhat shorter than its

head and body. The coat color is brownish gray. Black stripes show on the head, neck, and back, black-edged blotches on the sides and flanks, and solid black dots on the limbs and underparts. The marbled cat is found from northern India and Burma south to Sumatra and Borneo. It is rare everywhere. For this reason and because of its nocturnal habits it is seldom seen.

Fig. 44—*Marbled Cat*

The Golden Cat (*Felis temminckii*), about the size of a small collie dog, has longer legs than the marbled cat. The color of the pelage varies in different individuals from dark brown to red or grayish brown, the area along the back being darker. In the northern subspecies of this cat the body is often covered with spots and rosettes; these are rarely faintly discernible in southern subspecies. A form occurs in which the coat is black or nearly so. The face markings are alike in all color types of this cat except in the melanistic form. A pair of grayish bands

bordered with black passes from above the eyes over the forehead, and a conspicuous white band edged with black appears on the cheeks. The tail, which is from half to two-thirds the length of the head and body, is conspicuously lighter underneath than above. This cat ranges from China south through the Malay Peninsula to Sumatra.

The Fishing Cat (*Felis viverrina*) is somewhat larger than the domestic cat; the head and body are about thirty inches long, the tail about ten inches. It has short legs, a short tail, and a rather heavy body. The coat is harsher and its color is ashy gray with dark striping and spotting. The fishing cat is rather a drab-looking animal, for its fur lacks the luster seen in most cats. It is found from Burma and Formosa south to Java and Sumatra.

The Leopard Cat (*Felis bengalensis*), the common wild cat of southern Asia, is found from China and Formosa southward to Sumatra, Java, Bali, Borneo, and some of the islands of the Philippines. It is about the size of a domestic cat. This heavily spotted cat has the appearance of a small leopard; the color and spotting are very variable. The leopard cat of Sumatra (*sumatrana*) has fewer and smaller markings than the typical cat of the mainland; that of Borneo (*borneoensis*) is brighter and more rufous, while that of Java and Bali (*javanensis*) is duller. The smaller form (*minuta*) is found on Palawan, Panay, Calamianes, Negros, and Cebu in the Philippines.

The Bay Cat (*Felis badia*), restricted to Borneo, is uniformly colored; some obscure spots on its breast and occasional faint stripes on its face and cheeks provide the only trace of pattern. Two color phases of this cat appear—one mahogany-red, the other blackish gray. Both are black behind the ears and lack any trace of a white spot there. The length of the head and body is about two feet, of the tail sixteen inches. Very little is known of the habits of this rare cat.

The Flat-headed Cat (*Felis planiceps*), also with uniformly colored coat, is dark brown, darker on the back. Many of the

Fig. 45—*Leopard Cat*

hairs are tipped with white, which gives a silver-gray appearance. The white underparts generally have reddish spots, and the head is often distinctly striped. The reddish brown tail is quite short. The animal is rather short-legged in comparison with East Indian cats and is the smallest one—about the size of a small house cat. It is found from Malaya south into Sumatra and Borneo.

The Domestic Cat (*Felis domestica*) has been introduced on many of the islands and has reverted to the wild state. The cat on Timor, once named *Felis megalotis*, is now believed to be a feral domestic cat.

The Eurasian Lynx (*Felis lynx*) occurs on Sakhalin. It resembles the American lynx. All lynxes may be distinguished from other cats by their soft fur, bobbed tail, and tufted ears.

Seals, Sea Lions, and Walruses
Order Pinnipedia

The Pinnipedia are carnivorous mammals adapted to life in the water. Their limbs are modified into flippers and their bodies streamlined; both of these factors aid their aquatic life. The order is divided into three families. The fur seals and sea lions (Otariidæ) are characterized by small external ears, hind limbs capable of rotation forward to support the body, and long fore flippers. The structure of the limbs allows them to move on land with less difficulty than the remaining pinnipeds. The hair seals (Phocidæ) have no external ear, hind limbs incapable of forward rotation, and short fore flippers of little use on land. The walruses (Odobenidæ) are large, almost hairless, seal-like mammals with long tusks in the upper jaw, and thick, wrinkled skin.

Sea Lions and Fur Seals. Family Otariidæ

The Japanese Sea Lion (*Zalophus japonicus*) was wrongly described by Temminck in 1850 under the impression that it was Steller's sea lion. This very complete description includes a colored print of the animal and drawings of skulls and skeletons. It shows distinctly that the animal was smaller than the real Steller's sea lion. The skull characters depicted agree closely with those of the genus *Zalophus*, to which the California sea lion belongs. By some scientists it was thought to be the same animal as the California sea lion but Temminck's description of the external appearance as "straw colored with a darker throat and chest in the female" does not appear to be a good description of a California sea lion. The male was darker. The only known specimens are the series of skulls and skeletons which were described by Temminck and are in the Leiden Museum in Holland, and a single skull now in the British Museum. Additional material is greatly needed before the status of this animal can be assured.

The Steller's or Northern Sea Lion (*Eumetopias jubata*) is the largest of the sea lions. An old male reaches the length of thirteen feet and weighs more than fifteen hundred pounds. As with most sea lions, the females are much smaller than the males. The color varies from yellowish brown to dark brown. Steller's sea lion ranges from northern California north along the Pacific

Fig. 46—*Steller's Sea Lion*

coast through the Aleutians and south on the Asiatic coast to northern Japan.

In **the Australian Sea Lion** (*Neophoca cinerea*) the males are easily recognized by their large size and yellow crown and back of neck. The color of the rest of the body is dark brown, growing darker posteriorly. The females and immature males are light brown. The females are about five feet in length but there are records of old males being twice as long. The Australian sea lion inhabits rocky islands off the coasts of southern and southwestern Australia.

The Southern Sea Lion (*Otaria flavescens*) inhabits the Galapagos and the Juan Fernandez Islands. It is found also on the coasts of South America, from near the Galapagos Islands, south around Cape Horn, on the Falkland Islands, and north

up the Atlantic coast to the mouth of the Rio de la Plata. Seen at a distance, the sea lions seem to be colored uniform brown. The prominent manes are lighter in hue. Males, which have short faces and pug noses, may reach a length of nine feet; females are smaller.

The fur seals or sea bears differ from the sea lions chiefly because of their thick underfur and longer and luxuriant outer hair. The coat of a sea lion is short and lacks the underfur.

The Northern Fur Seal (*Callorhinus alascanus*), the animal from which seal-skin coats are made, is the best known of the fur seals. This animal's breeding ground is the Pribilof Islands in the Bering Sea, but in winter it migrates south as far as California and Japan. On account of the value of its fur the northern fur seal was rapidly becoming extinct, but following the purchase of Alaska, the United States government, after extensive research, protected the breeding colonies and controlled the killing of these animals. At the present time special government agents supervise the killing, and allow only young male seals three and fours years old to be killed. The number of fur seals is again increasing.

An adult male or bull is very dark brown, with grayish hairs on the shoulders. It is about six feet long and may weigh as much as five hundred pounds. The paler females are grayish brown and weigh only about one hundred pounds. The breeding of the northern fur seal is of special interest. Old males arrive on the breeding grounds on the Pribilof Islands in early May. They are in fat, healthy condition, and are at least six years of age. They fight among themselves, as each bull seeks to establish a small section or "station" on the coast as its own. About the middle of June the females or cows come ashore at the stations lorded over by the bulls. The number of females in each harem varies greatly; from twelve to fifteen, or as many as a hundred have been recorded. Soon after the females arrive the pups of the previous season's mating are born, generally one to each female. The main rutting season is in July.

By August the harems are scattered and the bulls, which all this time have ruled the harems, now leave for the water. They have become greatly emaciated, having eaten no food since their arrival in May.

During the summer, the non-breeding fur seals, chiefly made up of young males under six years of age, seek other sections of the shore, as the old males will not tolerate them. They congregate in great numbers at places called "hauling grounds." The fur seals to be killed for their skins are picked out and driven inland from these groups by the government agents.

The Southern Fur Seal (*Arctocephalus australis*) has nearly the same range as the southern sea lion. It occurs in the Galapagos Islands and differs from the northern fur seal by its longer muzzle and shorter, less dense hair. The underfur characteristic of the fur seal group is present. This animal has been killed in great numbers for its skin, for which reason it is now rare where once it was common.

The Australian Fur Seal (*Arctocephalus doriferus*) inhabits the shores of southern Australia. An old male may reach a length of six feet while the female is about a foot less. The color of both males and females is grayish brown above, buff-brown beneath; it appears blackish when wet. The habits of the animals are very similar to those of other fur seals. They have been similarly persecuted for their skins.

The Tasmanian Fur Seal (*Arctocephalus tasmanicus*) is similar in color to the Australian fur seal. The most noticeable differences are more robust bodies and larger heads of the males. There is also greater contrast between the sizes of the sexes, the females of this form being about the same length as females of *doriferus*. This fur seal is found along the coast of Tasmania and the southeastern coast of Australia.

The New Zealand Fur Seal (*Arctocephalus fosteri*), of the seas of southern New Zealand and southern Australia, has a long muzzle like the southern fur seal. It is colored grizzled gray, with chestnut-brown underparts, and there is generally a

gray spot below the eye. The males reach a length of six or seven feet, the females about one foot less. These animals have also been killed in large numbers for their skins.

Hair Seals, Earless Seals. Family Phocidæ

The Harbor Seal (*Phoca vitulina*) is found along the shores of both the north Atlantic and north Pacific Oceans. In the north Pacific, it ranges from Oregon northward to the Aleutians and Pribilof Islands, and thence southward on the Asiatic side of the Pacific to Japan. Its color varies from yellowish gray with dark brown spots to blackish with yellow spots. It is about five feet long; the sexes differ little in size. A number of subspecies have been distinguished, chiefly by skull characters.

The Ribbon Seal (*Phoca fasciata*), although about the size and build of the harbor seal, is very differently colored. It is dark brown, decorated with strongly contrasting yellowish bands about the neck, shoulders, and rump. This rare seal is found along the coasts of Alaska, the Aleutian Islands, and thence as far southwest as the Kurile Islands.

The Ringed Seal (*Phoca hispida*) has also the general shape and size of the harbor seal. The upperparts are blackish brown, covered with rings or blotches of yellowish; the underparts are yellowish. The distribution of this seal is circumpolar; it is found as far south as Kamchatka and Sakhalin.

The Bearded Seal (*Erignathus barbatus*), much larger than the harbor seal, attains a length of ten or twelve feet. It is usually plainly colored, grayish or yellowish, and darker along the back. The occasional individuals which show great variation in color can always be recognized by the tuft of flattened bristles on each side of the muzzle. The bearded seal is circumpolar and has been found on the Alaskan coast, the Aleutian, and on the northern Asiatic coast as far south as Sakhalin.

The Leopard Seal (*Hydrurga leptonyx*) is the best known of the seals of the southern seas. The color is ashy gray above, more or less spotted with black, sometimes with lighter blotches

on the back. The underparts are creamy white with black spots, especially about the tail and head. The male is ten feet or more in length, the female about seven feet. This animal resembles its namesake, the leopard, not only in its spotting but in its disposition. It is the fiercest of the seals and, preferring warm-blooded prey, feeds chiefly on penguins and other seals. The leopard seal is found throughout much of the Antarctic and during the winter as far north as the waters of southern Australia and New Zealand.

The Crab-eating Seal (*Lobodon carcinophagus*) is a slender animal reaching a length of nine feet. During the southern summer it is brownish gray, with some spotting along the sides but in winter the coat becomes creamy white. The teeth chiefly distinguish it; unlike those of other seals, they have several lobes which, when the jaws are closed, form a sieve. Water passes through but small crustaceans and other small sea animals, the chief food of this seal, are retained and swallowed. During the winter the crab-eaters come as far north as southern Australia.

Weddell's Seal (*Leptonychotes weddelli*) is common in Antarctica, and on rare occasions strays as far north as New Zealand. A specimen was once taken along the coast of southern Australia. It is a large seal reaching a length of nine feet, and is dark gray marked with blotches and spots of yellowish white. Its teeth are simple and peg-like.

The Southern Elephant Seal (*Macrorhinus leonina*) was formerly found on many of the islands of the south Atlantic, Pacific, Indian, and Antarctic Oceans and at one time as far north as Juan Fernandez. It has been slaughtered so persistently for its oil that only a pitiful remnant of the great herds of other years remains. Males may reach a length of twenty feet. Elephant seals get their name not only from their great size but also from the long inflatable probosces of the males.

The Hawaiian Seal (*Monachus schaunslandi*) is one of the monk seals; its relatives are found only in the Mediterranean

and Caribbean Seas. The Hawaiian seal appears to be confined to the leeward chain of islands of the Hawaiian Archipelago and may occasionally be seen on Layson Island, Pearl and Hermes reef, and Midway Islands. It is an exceedingly rare animal, having been massacred in times past for its hide and oil. Rigid protection is required if the species is to survive. Fortunately, it is found on some of the islands which are bird

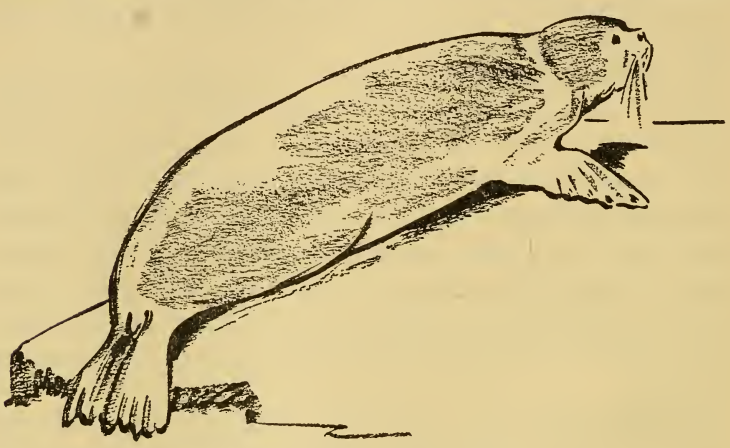

Fig. 47—*Hawaiian Seal*

sanctuaries. The Hawaiian seal is dark brown, tinged with gray above. The sides are lighter and the underparts are yellowish white. The newly born young are black, with long soft hairs.

The Walruses. Family Odobenidæ

The Pacific Walrus (*Odobenus divergens*) is found sparingly as far south as the drift ice of the Bering Sea and in small numbers in Bristol Bay. It becomes common north of the Bering Strait, and there are records of its occasional occurrence on the Aleutians.

The large size, the yellowish brown upperparts and reddish brown underparts, and the large ivory tusks found in both sexes will serve to identify this animal.

Scaly Anteaters. Order Pholidota
Family Manidæ

The family Manidæ contains the scaly anteaters or pangolins of Asia and Africa. One genus (*Manis*) alone occurs in the East Indies.

The Pangolin or Scaly Anteater (*Manis javanica*) is found throughout much of southern Asia and on many of the coastal

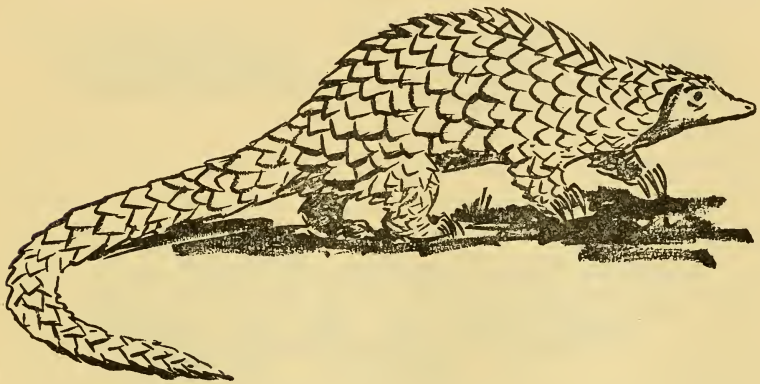

Fig. 48—*Pangolin*

islands from Sumatra to Palawan and Bali. It is light brown in color, with a narrow head, long nose and tongue. The upper-part of the body is protected by hard, overlapping scales, which give the animal the appearance of a large animated spruce cone; the underparts are without scales. When danger threatens, the pangolin rolls itself up to protect its belly. The scales at the side of the tail have sharp edges with which the animal, striking with the tail, can inflict deep cuts. The forefeet are armed with strong claws with which it digs holes in the ground for its home. The pangolin uses them to dig into the nests of ants and termites upon which it relies for food.

Gnawing Mammals or Rodents
Order Rodentia

The rodents or gnawing mammals of the Pacific and Malayan Islands comprise squirrels, rats and mice, and porcupines. (For rabbits, often included in the rodents, see Order Lagomorpha; for squirrel-like and rat-like mammals with more than two upper front teeth, see Order Insectivora, p. 37, or Order Marsupi-

Fig. 49—*Upper Right Cheek-teeth of Rice Rat, Black Rat, and Vole*

alia, p. 15.) All rodents have a single upper and a single lower incisor on each side, and not more than five upper and four lower cheek-teeth, often fewer. The squirrels look much like those of other lands and have similar habits, but some may be large and strikingly colored or have very long muzzles. By far the greater number of rats look much like the pests known to all, and especially in the villages, many are the identical kinds of black or brown rats common in the southern United States. In some seaports the Norway rat may occur. There are native rats on most of the islands east of the Solomons, which probably came as "hitch-hikers" on the boats of natives. West of the Solomons they were perhaps carried on natural rafts and drift-

wood as well. The Old World porcupines are either spiny or covered with very long quills; they are not found east of the Lesser Sundas or beyond Palawan Island, north of Borneo.

Squirrels and Flying Squirrels. Family Sciuridæ

The members of this family have bushy tails and their cheek-teeth number either five or four above and four below. The eyes are large; the muzzle in most species is broad and short. The size varies from that of a large mouse to giant squirrels and flying squirrels, which may reach the size of a house cat.

Flying Squirrels

Flying squirrels are found almost throughout the forested parts of Europe, Asia, and North America. The majority of the species occur in the Indian and Malaysian regions. Flying squirrels live on the Japanese Islands, Formosa, the Philippines (Palawan and Basilan Islands only), Sumatra, Borneo, and Java; they are also found on many of the small islands of this area, but are not known to reach Bali.

In contrast to most other squirrels, the flying squirrels are nocturnal in habit, sleeping through the day in holes or nests in trees or curled up in a fork. A thin, furry membrane stretches between the fore and hind limbs and in some species extends onto the neck and tail.

Giant Flying Squirrels (*Petaurista*) are variously colored; they may be foxy red, or red spotted with white or black. They occur from India to Japan, Palawan, and Java. The larger species are more than a yard in total length, the tail being about half of this. Their gliding membranes are the most extensive of the group and partly include the rounded tail. The large size of the "parachute" hinders movement in the trees so that these animals are less agile than other squirrels. Individuals have been known to glide distances of sixty to eighty yards. They control their direction and landing very well.

The Smaller Flying Squirrels (*Iomys, Pteromyscus, Petau-*

rillus, *Petinomys*, *Hylopetes*, *Belomys*, *Pteromys*) are diversely colored. Their sizes vary from that of a mouse (five and one-half inches in total length, of which the tail is half) to that of a rat (about twenty inches, total length). The several genera, many of which are poorly known, are distinguished by dental and skull characters.

Tree Squirrels

The tree squirrels are distinguished from the closely related burrowing ground squirrels (see beyond) chiefly for the reader's convenience. They extend east only as far as Celebes. Tree squirrels are typically diurnal forest dwellers.

Squirrels are sometimes confused with phalangers and tree shrews. Phalangers have very different skulls and teeth and a thumb-like first toe on the hind foot (see phalangers of the Order Marsupialia, p. 23). Tree shrews of China, India, the Philippines, Borneo, and Bali may be distinguished by the number of their incisor teeth—three on each side above and below (see Order Insectivora, Tupaiidæ, p. 43).

The Giant Squirrels (*Ratufa*) are black, reddish, dirty yellowish, with white or yellowish undersides. They reach a size almost as great as the giant flying squirrels, namely, from two to three feet in total length. They are found from the Asiatic mainland to Bali and Borneo.

Common Oriental Squirrels (*Callosciurus*) are both abundant and very varied. Some are striped above, some striped below, some are variegated black, red and cream, while others are olive-gray above and grayish below. The size of most equals or slightly exceeds that of the North American red squirrel—twelve to fourteen inches in total length, the tail a little less than half. They occur throughout the Malay region as far north as Formosa and east to Celebes.

Pygmy Squirrels (*Nannosciurus*) are little larger than mice. An exception (*N. murinus*), found in Celebes, thought to be related to pygmy squirrels, is as large as the common Oriental

squirrels. The pygmy squirrels proper are found from the Philippines and Borneo to Java and Sumatra. They are rarely collected and may occur unrecorded on other islands.

Ground Squirrels

The ground squirrels commonly live in burrows or among rocks. Some may be found in open country while others occur in the forest.

The Arctic Ground Squirrel (*Citellus parryi*), found on the more landward of the Aleutians as far west as Unalaska Island, is relatively large, its total length being about seventeen inches, of which the tail is about four and one-half inches. The upperparts are brownish, with irregular grayish spots, indistinct in worn pelage. The head is richer brown, the underparts rusty overlying grayish.

The Asiatic Chipmunk (*Eutamias sibericus*) resembles the common western chipmunks of the United States. Its dark back bears four whitish stripes and the sides are rust-colored. In length it is about nine inches, of which the tail is some four inches. Besides ranging widely in Siberia and northern China, the Asiatic chipmunk is present on the Kurile and the northern Japanese Islands.

The Red-cheeked Ground Squirrel (*Dremomys everetti*) has reddish cheeks and a relatively long muzzle. It is known only from a very limited area in Sarawak, Borneo. A closely related species occurs in Formosa and others in the mountains of China, India, and Malaya.

The Striped Ground Squirrel (*Lariscus*) is characterized by three or four black stripes on the back. It is found from the Malay Peninsula through Sumatra to Java and Borneo, as well as on some of the adjacent islands.

The Pygmy Ground Squirrel (*Glyphotes*) is a small squirrel with flank stripes of white and black and broad front teeth. It is known only from a very few specimens collected on Mount Kina Balu, British North Borneo.

The Tufted-eared Ground Squirrel (*Rheithrosciurus*) of Borneo has many grooves on the front of the upper incisors. The incisors are thick from front to rear, narrow from side to side. The body is reddish brown, with a white flank stripe running lengthwise. It is the largest of the ground squirrels; the total length is more than two feet, including the twelve-inch tail.

The Long-nosed Ground Squirrels (*Rhinosciurus*) of the Malay Peninsula, Sumatra, Borneo, and several nearby islands, are chiefly insectivorous. The small, weak upper incisors act with the lower ones like tweezers, while the tongue is said to be long and protrusible. The tail is short and bushy.

Another **Long-nosed Squirrel** (*Hyosciurus*) is found in Celebes. In contrast with *Rhinosciurus* it has very long claws, especially on the fore feet. Its incisors are normal. The dorsal color is dark brown, flecked with tawny; that of the underparts white.

Bamboo Rats. Family Rhizomyidæ

The Bamboo Rats (*Rhizomys*) of Sumatra and southern Asia are large and heavy-bodied, with small eyes and ears, short tail, and thick, silky, dark gray fur. Superficially they resemble American pocket gophers. Their lives are spent mostly underground amid the roots of dense stands of bamboo. They come out to cut bamboo and other plants, somewhat as woodchucks do.

Dormice. Family Gliridæ

Dormice resemble small squirrels in appearance and habits, but internally are more like rats. The fur is soft and velvety; the tail is well furred and the eyes large. Dormice hibernate during cold weather.

The Japanese Dormouse (*Glirulus*) is yellowish brown, with a slight ashy color showing through from the bases of the hairs. A broad, dark brown stripe runs from the back of the head to the base of the tail. Although this dormouse is little larger than

the house mouse, the body is considerably heavier; its total length is about five and one-fourth inches, of which the tail is about two inches. It is known from Hondo and Shikoku Islands, Japan.

Old World Rats and Mice. Family Muridæ

Although the rats and mice of this family belong to the Old World, some of them have spread wherever men are found. Rats and mice of American origin, some of which occur in the Galapagos Islands near the coast of South America, together with the northern voles and lemmings of both hemispheres, belong to a different family, the Cricetidæ (see p. 119). The only rodents that occur in the South Pacific area between Celebes and the one-hundredth degree west latitude are Old World rats and mice. This is a complex and varied group, basic differences of which reside chiefly in the structure of the skull and teeth. Many of them look like common house rats. Two subfamilies occur on the islands between the Malay Peninsula and Australia; only one of these subfamilies, the typical rats, is found east of the Solomons.

Typical Rats and Mice. Subfamily Murinæ

The cheek-teeth of most of these rats are simple, their cusps forming parallel transverse ridges, three ridges on the first molar, two on the other two. Before it becomes worn each ridge consists of three cusps, the central one slightly larger than the outer and inner ones. Although this seems a rather small feature, it has been characteristic of the family for a long period of time.

The House Mouse (*Mus*) is so well known that it may be thought unnecessary to describe it. Most specimens found between the Malay Peninsula and the Marquesas Islands are slightly more reddish than the house mice of the United States and western Europe; east of this region and north of it the mice are the same as at home. Adult house mice vary from

about seven and one-half to eight and one-fourth inches in total length, of which slightly more than half is tail.

Two small mice are about the same size as the house mouse and are not very unlike it.

The Wood Mouse (*Apodemus*) of Formosa, Japan, and the Kuriles, is a Eurasian type found from the British Isles to eastern Asia. The tail is long and nearly naked. Wood mice are yellowish brown above, white below, and have white feet.

The Pygmy Tree Rat (*Hæromys*), found in North Borneo and Celebes, has the tail longer than the house mouse, and the first toes on front and hind feet are thumb-like and opposable.

The Common Rats (*Rattus*) are world-wide in distribution. Three kinds of rats have been carried involuntarily by man during the last three hundred years to the ports of the Pacific, whence they have spread widely. The Norway or brown rat (*Rattus norvegicus*), which is the common house rat throughout the northern United States and Europe, is the largest of the three, measuring fifteen or sixteen inches long with the tail a little less than half of this; the females are smaller. The brownish gray fur is coarse, and the ears small. The scales of the tail number about twenty-five to the inch. In the tropics this rat is usually confined to seaports. The black rat and Alexandrine or roof rat, color varieties of a single species (*Rattus rattus*), are even more widespread in the warmer countries. They are relatively large animals, sixteen or seventeen inches long, with the tail a little more than half this length. The tail scales are finer than in the Norway rat, and the ears are large, reaching to the middle of the eye when laid forward. The black rat is recognized by its color, but the roof rat is colored much like the Norway rat and many native ones. Wild races of *Rattus rattus* are known in the islands between the Malay Peninsula and Celebes; east of this they are replaced by other species.

The small rats commonly living in native houses on the islands are all members of the *Rattus concolor* group, which occur from the mainland of Asia to Hawaii and the Marquesas Islands. The

size of these rats varies from nine to twelve inches in total length, the tail usually a little longer than the head and body. They were almost certainly carried to the various islands in native boats when men first settled Oceania. A number of related wild species are also to be found on the Greater Sunda Islands and the Philippines.

The Bandicoot Rats (*Bandicota*) are partly adapted for life underground, but to a far less degree than the bamboo rats, described earlier. The front claws are large, the muzzle short and broad. The incisor teeth are broad and the cusps of the molars soon wear down to form almost straight cross-ridges. The adults reach a large size—total length, eighteen or twenty inches, of which the tail is almost half. Bandicoot rats are found on the islands of Formosa, Sumatra, and Java, as well as on the mainland.

The Red Tree Rat (*Pithecheir*) of Java and Sumatra has long soft reddish fur, which extends for almost an inch on the base of the tail. The teeth have high cusps which remain distinct until old age. The size of this rat equals that of common house rats. The first toe of the hind foot is thumb-like and opposable, whence its scientific name meaning "ape hand."

Shrew rats, with long wedge-shaped head and often velvety fur, are found on Java, Sumatra, Celebes, and the Philippines.

The Shrew Rat (*Mycteromys*) of Java and Sumatra has teeth much like those of the house mouse, but the first molar is about one-third larger than the other two combined, and the lower incisor is longer than usual.

The Celebes Shrew Rats (*Echiothrix* and *Melasmothrix*) have unusual incisors, the upper ones short and weak, the lower ones long. The first species, larger than a house rat, has spiny pelage; the upper incisors are whitish rather than the yellow usual in rodents, and each has a distinct groove down the face. The cheek-teeth are very small. The second kind on Celebes is about eight and one-half inches in total length, with the tail less

than half of this; the fur is velvety, blackish bay in color. Both are quite rare.

The Philippine Shrew Rat (*Rhynchomys*) is known only from the mountains of northern Luzon. Its total length is about fourteen inches, including the five-and-three-fourths-inch tail. The velvety fur is dull olive-gray. The upper incisors are white, short and weak; the cheek-teeth minute and only two in number on each side. Its teeth suggest that it may feed only on soft-bodied insects and worms, but nothing is known of its habits and only a very few specimens have been taken.

Giant Rats (*Hyomys, Anisomys, Uromys*), heavy-bodied and about two and one-half feet in length, occur in New Guinea. They are not closely related to one another but look much alike. The New Guinea mosaic-tailed rat (*Uromys*) also reaches northern Australia and the Solomon Islands. The smaller mosaic-tailed rats (*Melomys*), closely related to *Uromys*, are only eight to fourteen inches in total length. Like *Uromys*, they have nearly naked tails, the scales of which do not overlap but are set edge to edge. These rats (*Melomys*) are found from the Talaut Islands and the Moluccas to the Solomon Islands and Australia.

Many other rare and little-known rats with cheek-teeth of simple, *Rattus*-like pattern occur on the islands between the Malay Peninsula, the Philippines, and the Solomons.

Certain Indo-Australian rats which look much like house rats have complex teeth, the patterns of the cross-ridges in the upper cheek-teeth trefoil-like rather than simple crescents or straight lines. *Lenomys*, which represents this group in Celebes, is about twenty or twenty-two inches in total length, with the tail about half of this. *Mallomys* of New Guinea is much larger, two to two and one-half feet in total length, with the tail about fifteen inches.

The Complex-toothed Tree Mouse (*Chiropodomys*) of Sumatra, Java, and Borneo is small, the different forms varying from about six inches to a foot in total length, with the tail

usually longer than head and body. The first toe on its hind foot is opposable as in several other tree rats. The tree rats of this group (*Pogonomys*) found on New Guinea and adjacent islands have a prehensile tail, the tip of which curls upward.

Two large **Bushy-tailed Rats** (*Phlæomys* and *Crateromys*) are found in the northern Philippine Islands: Luzon, Mindoro, and Marinduque. They are two feet or more in total length, with the tail about three-fourths of the head and body length. Their molars, especially those of *Phlæomys*, have cross-ridges of more simple pattern, not very different from those of the bandicoot rats.

The indigenous Australian rats are far more diversified than is generally realized. In addition to a number of distinct species of *Rattus* (allied to house rats), Australia contains a number of distinct genera fully as striking as are those characteristic of New Guinea.

Australian Native Mice (*Pseudomys, Thetomys, Leggadina, Gyomys*) are about the size of house mice—some even smaller. The color, depending on whether they live in forest or desert, varies from dark to very pale gray, with underparts whitish. They are distributed all over Australia.

The Broad-toothed Rat (*Mastacomys*) is a large, dark-colored, short-tailed species remotely related to other Australian rats. It is found only in Victoria and Tasmania.

The Thick-tailed Rats (*Laomys*) are characterized by the pronounced swelling of their tails just beyond a very slender constriction at the base. They occur in central and northwest Australia.

The White-tailed Rat (*Zyzomys*) is about eight inches long, the tail four or four and one-half inches of this. The tail is white, more thickly haired than usual among rats and has a small tuft of hair at its end.

The Rabbit Rats (*Mesembriomys*) are very large rats with rather large ears and elongated feet. Several races occur. The over-all size is twenty to twenty-three inches, with the tail twelve

to thirteen inches long. They are found only in the north of Australia. The only other large rats of northern Australia are the mosaic-tailed rats (*Uromys*), already mentioned as having headquarters in New Guinea.

Lesser Rabbit Rats (*Conilurus*) are easily separated from the preceding. The color above is blackish brown or dark gray instead of reddish brown with touches of creamy buff. The underparts are white. In total length they are about fifteen inches, with a tail about eight inches. They are found in northern Australia; one race has been recorded in the extreme south of New Guinea.

Nest-building Rabbit Rats (*Leporillus*) are soft-haired, gray rats with large ears and white feet, marked with darker gray in one species. They are noted for making large nests, which may reach a height of three feet and a diameter of four, by weaving twigs together, using a growing bush for the framework. Several entrances are provided. In the center is the brood chamber, lined with soft materials. These rats are limited to the southern parts of Australia.

Australian Kangaroo Rats (*Notomys*) superficially resemble the kangaroo rats of the western United States, although they belong to a wholly different family of rodents. The hind legs are similarly elongated and kangaroo-like, and the long tail bears a tuft of hair at the end. In one species a throat pouch is present. The size is small: the total length is from eleven to fourteen inches, with the tail occupying from six to nine inches. The distribution includes most of Australia.

Water Rats. Subfamily Hydromyinæ

The Australo-New Guinean Water Rats (*Hydromys*, *Leptomys*, *Pseudohydromys*, and others) have basined cheek-teeth, with few cross-ridges, and the infraorbital canal of the skull is wide, not slit-like as in the other rats. With the exception of *Leptomys* and the newly discovered *Baiyankamys* of New Guinea, these rats have only two molars in each jaw. As the

name water rats implies, most of the members of this subfamily are aquatic. Exceptions are a small species (*Xeromys myoides*) from Queensland, *Leptomys* and *Paraleptomys*, and probably *Baiyankamys* from New Guinea. True water rats are found also on the adjoining islands, New Guinea, New Britain and Kei, Aru and D'Entrecasteaux Islands, in addition to Australia.

Celænomys, *Chrotomys*, and *Crunomys* of Luzon—the last also in Mindanao, the Philippine Islands—are thought also to belong with the water rats. The molar teeth of *Chrotomys* are basined like *Hydromys* but they are three in number instead of two. *Chrotomys* is strikingly marked with a bright buff stripe from head to rump, bordered by black. *Crunomys* agrees with the common rats in tooth pattern, but the flattened shape of its skull suggests modification for life in water. *Celænomys* is slaty gray; it agrees with *Hydromys* in having only two cheek-teeth on each side above and below and in the basined character of the teeth. These Philippine rats may be distantly related to the Australian forms or the resemblances may indicate convergence.

Voles, American Rats and Mice
Family Cricetidæ

The voles of the northern hemisphere and the rats native to the western hemisphere differ from true rats by having only two rows of cusps on the upper molars, instead of three. When the teeth wear down, these cusps form a more or less distinct zig-zag pattern, instead of cross-ridges. Although this difference seems small, it has characterized the two groups for millions of years.

The Red Lemming (*Lemmus*), which is probably to be found on the landward islands of the Aleutians, is a small, thick-set rodent with short hairy tail, small ears, and long, soft fur. The body color is rusty, grizzled on the head and shoulders. Locally this lemming may become abundant, but over much of its range it is scarce, at least during certain years. It is a close relative

of the famous Norwegian lemming which during its years of abundance makes great migrations, often ending in what looks like mass suicide, plunging into the sea and swimming out until drowned. The migrations of our lemmings are less well known and less extreme, but they have a similar cycle of alternating abundance and scarcity. The total length of this vole is about five inches, of which the tail is about one-half inch, excluding the hairs.

The Collared Lemming (*Dicrostonyx*) may also occur on the Aleutians nearest the mainland. It is colored gray, darker or black down the middle of the back, and has a reddish collar. In winter it turns white and develops very large claws. It is about six inches in total length.

The Lemming Mouse (*Synaptomys*) may also be found on the Aleutians. It is dark gray. Its total length is a little less than five inches, and the tail, which lacks long hairs, measures about three-fourths of an inch. The upper incisors are grooved.

The Meadow Mouse (*Microtus*), often called vole, is found in Japan and the Kuriles. The tail is longer than those of its relatives described above, but measures less than two inches; the total length of the animal is about five inches.

The Red-backed Mouse (*Clethrionomys*), found in the Kuriles and Japan, is about the size of the meadow mouse, but is usually characterized by a rusty band down the back, contrasting with the grayish sides. Its teeth are slightly different from those of the meadow mouse. As in the rest of the group described above the cheek-teeth have a strongly marked zig-zag pattern, but they are rooted.

On the Galapagos Islands, off Ecuador, there are several species of rats belonging to the genus *Oryzomys*, abundant in Central and South America, and closely related to our rice rats. They must have reached those islands by drifting on natural rafts, for they were there before men came to the Galapagos and had developed into distinct species. Since the distance involved is more than five hundred miles, their presence on these

islands is even more remarkable than that of the bat (*Lasiurus*) found there.

Jumping Mice and Their Allies. Family Zapodidæ

The Striped Tree Mouse or Birch Mouse (*Sicista*), ranging from Norway and Hungary to eastern Siberia, is found on Sakhalin Island. It looks more like the true mice than its relatives the North American jumping mice. As in the latter, the cheek-teeth are four above, three below, and the forward opening from the bony eye-socket is large and rounded, rather than constricted and slit-like. The striped tree mouse is yellowish brown above, yellowish white below; a black stripe runs down the middle of the back from the crown to the tail. The total length is five and one-fourth to six inches, of which the tail is three to three and one-half inches. The striped mouse lives in open birch woods as a rule, and feeds on seeds. It sleeps through the winter in cold climates in a nest built in a hollow tree or protected place.

Old World Porcupines. Family Hystricidæ

Although they are thought to be related to the American "quill-pigs," the porcupines of southern Europe, Africa, and Asia differ much from them. They do not climb trees, and they have hollow quills on the tail which are long and firmly attached to the skin and which rattle when they are alarmed. Porcupines are represented in the Greater Sunda Islands by three genera. The meat of all is good to eat and tastes somewhat like pork.

Old World Porcupines (*Hystrix*) occur on the larger islands from Sumatra to Sumbawa (and possibly Flores). They are about twenty-seven inches in total length; the tail occupies about five inches of this, excluding the quills. The animals weigh about eighteen pounds. The head and shoulders are covered with short spines but from the back and rump arise larger stouter quills, six or eight inches long, banded with black and white. Even longer, but thin flexible quills project beyond this

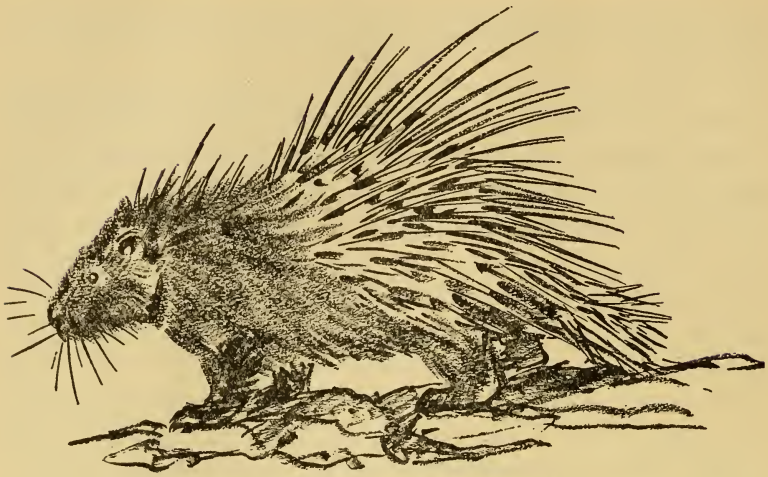

Fig. 50—*Asiatic Porcupine*

armor. A porcupine tries always to keep its rear directed at an enemy; the quills are erected by strong skin muscles and the animal is said to run backward. For the most part porcupines are nocturnal and feed largely on roots and succulent vegetation.

Brush-tailed porcupines (*Atherurus*) have almost as wide a range as the common porcupine, but they are not found east of Sumatra. They look like large, blunt-nosed, spiny rats, with the relativity short tail ending in a tuft of hollow quills, each of which somewhat resembles a string of flat beads. The spiny quills that cover the body are grooved; most of the stiff spines are about two inches in length, although some of the thin ones are three times as long. The brush-tailed porcupine is about thirty-two inches in total length, of which the tail is about one-third.

The Long-tailed Porcupine (*Trichys*) resembles its brush-tailed relative, but its spines are shorter and the hairs of the long tail are parallel-sided. This rare porcupine is found only in Borneo and Sumatra.

Fig. 51—*Brush-Tailed Porcupine*

Rabbits and Their Allies. Order Lagomorpha

The rabbit family and the related group which contains the mouse-hares or pikas, resemble the rodents by having a large space between the incisors and the cheek-teeth and by having a single pair of lower and one functional pair of upper incisors. A second small pair of incisors is present behind the functional upper pair. The enamel is not confined to the front of the incisors, as in the rodents. The lower jaw moves from side to side in chewing, rather than back and forth, and there are also many internal differences between the rabbits and the true rodents.

The members of the rabbit family are much alike; they differ chiefly in size, length of ear, and precise pattern of the teeth. The tail varies in size and conspicuousness, but it is always visible. The pikas or mouse-hares have ears that project only slightly above the top of the head, and their hind feet and legs are not more elongated than those of squirrels; the tail is not visible externally.

Rabbits and Hares. Family Leporidæ

The Arctic Hare (*Lepus poadromus*) is likely to be present on the landward Aleutians. This is a large hare, about two feet in total length, and heavily built. In winter the animals become white, excepting only the black-tipped ears, while in summer they are dull grayish brown, with white hind feet. The short ears measure about three and one-fourth inches from the notch. Arctic hares are larger as a rule than our snowshoe rabbits and the Eurasian varying hare. They differ little from those animals.

They form one of the principal foods of foxes, wolves, and great snowy owls in the regions where they are found. The seasonal change in color aids them to escape from their enemies; their summer coat blends with the vegetation and their winter coat makes them almost invisible on the snow, so long as they stay still.

Eurasian Varying Hares (*Lepus timidus*) resemble American snowshoe rabbits. Their color is dull grayish brown in summer and white in winter excepting the tips of the ears. The head and body length is about twenty inches; the ears measure about three and one-half inches from the crown of the head. This species ranges from Scotland and the Scandinavian Peninsula through Siberia to the northern Japanese Islands and the Kuriles.

The Japanese Hare (*Lepus brachyurus*) occurs on the southern Japanese Islands. It has short ears—less than three inches long—and is a little smaller than our varying hare. Its color is dull brown, with the head, neck, belly, and limbs russet. The tail is scarcely longer than the hair of the rump; it is brownish above and dull whitish below.

The Black-naped Hare (*Lepus nigricollis*) was introduced into Java from Ceylon or India. This species is dull brown, mixed with blackish on the sides and back, becoming paler on the feet. A band of blackish brown forms a collar around the

neck, whence its name is derived. In size and proportions it is not very different from the American snowshoe rabbit.

The Formosan Hare (*Caprolagus formosus*) is closely related to the harsh-furred hare of southern China. Its color is grayish drab, mixed with black, the tips of the hairs mostly buffy. Its dimensions nearly equal those of our cottontails, the tail being shorter but the other proportions similar.

The Luchu Islands Rabbit (*Pentalagus furnessi*) has only five upper cheek-teeth, instead of the usual six in this family. Its color is very dark brownish black, with an admixture of buffy, becoming mahogany-colored on the rump; the feet and tail are yellowish brown. The back has a jet-black stripe extending from the neck to the beginning of the mahogany color on the rump. The ears are proportionately short (less than two inches in length), but the body is about the size of the American snowshoe rabbit; the hind feet are smaller. This rabbit, known only from a few specimens, is one of the rarest mammals in museum collections.

The Sumatran Hare (*Nesolagus netscheri*), of peculiarly striped appearance, is grayish yellow on the front parts, gradually becoming rich mahogany-brown on the haunches. A black stripe begins at the nose and runs the whole length of the animal; it broadens between the ears, and on each side a black band runs forward from the back of the neck onto the cheeks. A black stripe extends back from the shoulders to join the dorsal stripe near the haunches and yet another black band comes up from the groins a little behind this. The outersides of the thighs are black, as is also a band around each hind foot. The fur is short and woolly and the ears are short—about one and one-half inches in length. This rabbit is a little larger than the cottontails of the United States.

The European Rabbit (*Oryctolagus*), introduced into Australia in 1788, has since assumed the proportions of a first-class pest, having destroyed enormous acreages of grazing lands. Certain values have eventually emerged: rabbit fur is made into

felt hats or imitations of popular skins, and during World Wars millions of frozen carcasses are eaten as meat.

Pikas. Family Ochotonidæ

The Pikas, Conies, or Mouse-hares are only half as large as cottontails. They have mouse-like ears but no visible tail. A single species (*Ochotona hyperborea*) occurring on the large island of Hondo or Honshu, Japan, is found in rocky places, probably above the timber-line. Pikas have a peculiar call—a long ventriloquistic whistle or bleat. Piles of "hay" which they gather under the shelter of large stones are often the only signs of their presence.

Whales and Porpoises. Order Cetacea

Whales and their smaller relatives are mammals that have become greatly modified for life in the water. Their forms are fish-like, rounded and tapering, without a constriction at the neck. The tail, broadened and flattened, is shaped into a propelling organ much like a fish's tail, but is horizontal instead of vertical. The front limbs are paddle-like, but no external trace of the hind limbs remains. The skin is hairless, smooth, and shining; immediately under the surface lies a thick layer of fatty tissue or blubber. There is usually a median fin on the back. The eyes are small for the size of the head. There is no external ear, and in some cases the middle ear is completely separated by thick tissue from the exterior. The opening of the nostrils, through a paired or single "blowhole," is almost as far back as the eye or even behind it. These mammals will rarely be seen close enough to assure their identification. Some may be seen washed up on the beaches, and a few species live in the mouths of rivers or in harbors. Great gaps exist in our knowledge of these sea mammals, as they are too large for us to keep under observation in aquariums or for us to attach recording machines to them. The distribution of small species of little commercial value is still poorly known. Records of such whales

and porpoises, especially if accompanied by photographs and skulls, are very desirable.

Whalebone Whales. Suborder Mysticeti

Whalebone whales have no teeth, although there are rudiments formed in the embryo. In the place of teeth the upper jaw has developed rows of horny, fringe-like whalebone which function as a sieve. The mouth opens wide and a great quantity of water is taken in. The mouth is then closed and the water forced out through the whalebone by the tongue, leaving the small fish and shrimp-like animals caught by the sieve to be swallowed.

The Pacific Right Whale (*Eubalæna*), both southern and northern species, has the body tapered gradually to the base of the tail. The head occupies about one-fourth of the total length, which is about fifty feet in adults. These whales have no throat grooves nor do they have a dorsal fin (compare with the finback whales).

The northern right whale is almost restricted to the waters north of the fortieth parallel, and although usually found far from shore, is taken off the coasts of Japan, Kamchatka, and the coast of Alaska.

The southern right whale is found largely between thirty and fifty degrees south latitude; in the Pacific it has been taken in numbers off southern Australia, near New Zealand, and off the coast of Chile. Other records are rare.

The Bowhead or Greenland Right Whale (*Balæna*) is more massive than the other right whales. The head occupies about one-third of the total length, which in adults is from fifty to sixty feet. The head is thicker and more arched in dorsal profile than the northern and southern right whales, and the body tapers less regularly to the base of the tail. The bowhead is found in the Arctic Ocean and in the Bering and Okhotsk Seas, but it may range south of these last two regions in the winter. This species is now rare.

The Pygmy Right Whale (*Neobalæna*) is about twenty feet long, the head being about one-fourth of the total length. The color of the whalebone is pale yellow margined with black, while that of other right whales is usually black. The pygmy right whale is found in New Zealand and Australian waters and off South America.

The Gray Whale (*Rhachianectes*), like the several foregoing species, lacks the dorsal fin, but the back shows a number of wave-like bumps, especially toward the tail. The head is small—less than one-fourth of the total length. The throat has two longitudinal folds, about six feet in extent, and the body is more slender than that of the right whales. The whalebone plates are only about fifteen inches in length. Adults are thirty-five to forty feet long. The gray whale, found chiefly near the coast, was once common along the Pacific coast of North America and in the Sea of Japan, but whaling has almost exterminated the species.

The Humpback Whale (*Megaptera*) frequents the coasts and bays of all the great oceans. Adults generally reach a length of about fifty feet. The body is thickset and clumsy in build. The fins are very long, about fourteen feet from base to tip in adults, and the front margin is irregularly wavy. The throat has a number of longitudinal folds, like those of the related finbacks. The humpback's blow or spout (the mixture of air and water spouted from the blowholes) is short and broad, rising almost vertically. The humpback is one of the few good-sized whales that can jump clear out of the water. Like most whalebone whales it feeds on small shrimps but eats a few fish as well.

Finback Whales or Rorquals (*Balænoptera, Sibbaldus*) include the largest of all known animals, the blue whale or sulphur-bottom. This species (*Sibbaldus musculus*) reaches a length of slightly over one hundred feet and a weight of more than one hundred tons. Its spout is more than fifteen feet high, and like that of most whalebone whales is almost vertical. Other kinds

Fig. 52—*Hump-backed Whale*

of finback whales are smaller, from twenty-five to sixty-five feet in length.

Finbacks are slender of body, with a dorsal fin; the head is one-fourth or less of the total length, and the "muzzle" is broad rather than deep. The throat and breast have numerous longitudinal folds, and the whalebone is short and coarse. Finbacks are found in almost all seas, but they are commoner in the cooler waters than in the tropics. These whales are the species now hunted commercially, most of the others being too rare to be profitable.

Toothed Whales, Dolphins, and Porpoises
Suborder Odontoceti

Adult toothed whales always have teeth, but in some cases these are not functional. The teeth are usually numerous and peg-like, and the nostrils open by a single blowhole. The small toothed whales with long, pointed "beaks" are usually called dolphins; those without "beaks" or with small, rounded ones, and with bulging "foreheads" are called porpoises.

The Sperm Whale (*Physeter*) reaches a large size; the males are as long as eighty-five feet, but the females are much smaller. The head occupies almost one-third of the total length. The upper jaw and muzzle are barrel-shaped; the lower jaw, bearing the teeth, is slender and pointed. The spout is directed diagonally forward and is "slow." Sperm whales are often found in

schools of fifteen or more (once schools of a hundred were not uncommon), and they feed on squid, octopus, and some kinds of fish. Although these whales are commonest near the equator all across the Pacific, they are found also between fifty degrees south latitude and forty degrees north, with concentrations off New Zealand and Australia, and between Hawaii and Japan.

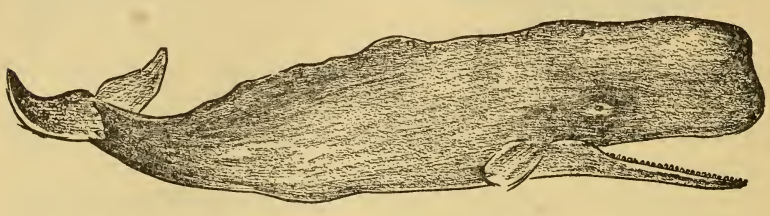

Fig. 53—*Sperm Whale*

Ambergris, a substance used as a base for perfumes, is a product of the sperm whale, formed in the digestive tract. It is usually grayish in color, with a sweet, slightly musty odor. It is so valuable that for months after some has been found, bits of waste fat or soap, mistaken for it, are hopefully brought to museums for identification.

The Pygmy Sperm Whale (*Kogia*) is much smaller than the sperm whale. It attains a length of about twelve feet. The head is short and rounded and a dorsal fin is present. It is found in all seas, but seems to be rather rare.

The Bottle-nosed Whale (*Hyperoodon*) is about twenty-five to thirty feet in length when fully grown. Its body is rather heavy; the "forehead" bulges, and there is a well-developed "beak." In color this whale varies from dark gray to black above and lighter on the underside. There are only two small teeth, situated one each side at the tip of the lower jaw and hidden in the gums. The bottle-nosed whale is known to occur off the west coast of Australia; records in the islands to the north are lacking.

The Baird Whale (*Berardius*) is rare. It is found from the Bering Sea to California and may occur off Japan. A second

species is reported from near New Zealand, but not elsewhere in the southern Pacific. Both species have two large teeth, roughly triangular in shape, one on each side of the lower jaw. Dorsally they are black with the underside whitish, gray, or flecked with black. They have a well-developed forehead and a long and heavy beak. The northern species reaches about thirty feet, the southern about forty.

Cuvier's or Goose-beaked Whale (*Ziphius*) is about eighteen feet in length. It varies above from black to gray or even white, at least on the foreparts. A single pair of teeth is present, situated near the tip of the lower jaw. It is recorded from off Australia, New Zealand, and Java.

Typical **Beaked Whales** (*Mesoplodon*) of several species occur in Australian and New Zealand waters; another is found from the Bering Sea to California and may be expected in Japanese waters. All species have a single pair of teeth in the lower jaw; in some species these teeth are sometimes large and situated about the middle of the jaw, and in other species they are poorly developed and placed near the tip. Beaked whales are from ten to twenty feet long, depending on the species; the beak is long and the forehead poorly developed.

The Killer Whale (*Orcinus*) is black in color, with distinctive white markings on the underparts and sides. The dorsal fin is large, situated near the middle of the body, and the flippers are broad and paddle-like. Killers are twenty to thirty feet long and have from ten to twelve large conical teeth on each side of the upper and lower jaws. They are found in all seas. They feed normally on large fish, smaller dolphins, and seals. Occasionally they form packs like wolves to attack larger whales and may be dangerous to a person in the water.

The Gray Porpoise or Risso's Dolphin (*Grampus*) has a high, sickle-shaped dorsal fin, much like that of the killer whale. It is only about ten feet long, however, and grayish in color, with a pale head. It has hardly any beak; the front of the head rises almost vertically from the tip of the upper jaw and the forehead bulges. The flippers are long and narrow. Risso's

dolphin is found near the coasts of New Zealand and eastern Australia and in the northern Pacific, from California and Japan to the Aleutians.

The False Killer Whale (*Pseudorca*) is completely black and more slender in shape than the killer. The long and tapering flippers comprise about one-tenth of the body length. The short dorsal fin is directed backward. Eight to eleven pairs of large teeth much like those of the killer in appearance are found in both jaws. Cuttlefish or squids are the chief prey of this porpoise. The false killer is twelve to fourteen feet in length. It lives in all seas.

The Irrawaddy Dolphin (*Orcella*) is about seven feet long. The short head has a bulging forehead and narrow, shelf-like beak. The color is slaty blue. The teeth number twelve to nineteen on each side of the upper and lower jaws. This dolphin feeds on fishes. It is found in the Straits of Malacca and Macassar and near the shores of the South China Seas.

The Blackfish or Pilot Whale (*Globiocephala*) is almost world-wide in distribution. The head is greatly swollen in front, the forehead bulging out above the upper jaw. These whales are about fifteen to eighteen feet in length. The teeth, ten on each side, are located at the front of the jaws. Blackfish live for the most part on squid. Large schools of blackfish occasionally beach themselves without obvious reason.

Dall's Porpoise (*Phocœnoides*) has no beak. The body is black, with a large white area on the underside extending to the sides of the hinder half. The teeth are small; twenty-three are found in the upper jaw and twenty-seven in the lower on either side. This porpoise is found in Alaskan waters south to California, and True's porpoise, a closely related species with the white marking covering most of the sides, is found off Japan.

The Harbor Porpoise (*Phocœna*) slate gray and less than six feet long, occurs along the North Pacific shores.

The Finless Black Porpoise (*Neomeris*) is found from the coasts of southern Japan and Formosa to the Cape of Good

Hope and is fairly common in the Malay region. It is about four and one-half feet long, with a bulging forehead, and has from fifteen to nineteen pairs of teeth in each jaw.

Right Whale Dolphins (*Lissodelphis*) were given this name because they have no dorsal fin and thus resemble the right whales. They are small—six or eight feet long—slender, and have a distinct beak. The southern species, found near New Zealand and southern Australia, has a black back and white lower parts, the white including the beak. The northern species, found in the Pacific from California northward, is black, excepting a white area on the breast and a stripe of white extending from this region to the tail. The right whale dolphins have many small teeth: forty-three on each side of the upper and lower jaws in the southern species; forty-four pairs in the upper and forty-seven pairs in the lower jaw of the North Pacific form.

The White-headed Dolphin (*Cephalorhynchus*) is one of the common New Zealand species. Its body is light gray, with the nose and forehead pure white, gradually passing into the color of the body. It is about four feet long and has thirty-one or thirty-two teeth on each side of the upper and lower jaws. Another species, Hector's dolphin, from the same region, has the beak more developed. Its upperparts are blackish, its underside white, and a narrow band of white extends back on the sides toward the tail. It is about six feet long and has about thirty pairs of teeth above and below. Related species are found in the waters off the Cape of Good Hope and the southern tip of South America.

Several species of the genus *Lagenorhynchus* are found in the Pacific. They have high, sickle-shaped dorsal fins, not unlike those of the killer whale and *Grampus*, and the beak is usually poorly marked. The white-sided dolphin of the North Pacific Ocean is black above, with an irregular white area on the side, which comes up about to the level of the eye. The flippers are black. This dolphin is about seven feet long, and has twenty-seven teeth on each side of upper and lower jaws. The

hour-glass dolphin is five or six feet in length and has a distinct, though short, beak. The white markings on the sides consist of two torpedo-shaped areas, one from above the eye tapering back to the level of the dorsal fin and the other from the base of the tail tapering forward to join or almost join the first. The flippers are black and so is an irregular band from the eye to the tail separating the white of the sides from that of the underparts. The white areas of the sides are connected in front of the eye. This species is found in the southern Pacific. The dusky dolphin of New Zealand and the Falklands has a longer beak than its relatives. The white of the underside extends up on the side to about the level of the eye, and there is a whitish marking on the rear part of the dorsal fin. The back is dark brown. This species is common in the seas around New Zealand. Another species, very poorly known, is reported from the tropical Pacific, but it is known only from the skull.

Bottle-nosed Dolphins (*Tursiops*) have high, sickle-shaped dorsal fins, a rather heavy body, swelling forehead above a short beak, and the lower jaw longer than the upper. The upperparts are gray or blackish, the underside white. One species in Australian waters has the sides, lower surface, and flippers covered with dark blotches. Other species lack these blotches and are found in all temperate and tropical seas.

The Common Dolphin (*Delphinus*) has a narrow, relatively long beak (five to six inches) that is sharply marked off from the forehead by a V-shaped groove. The body is black or dark gray, and on each side are undulating bands of whitish, yellowish, or gray; the eye is circled by a ring of blackish and a line connects this with the snout. The upper and lower jaws bear forty to fifty pairs of fine teeth. The common dolphin is about seven and one-half feet long. It is found almost throughout the world. A small, closely related species is the red-bellied dolphin (*D. roseiventris*) found in the Banda Sea and Torres Strait. It is stouter in build, and about three feet ten inches in length.

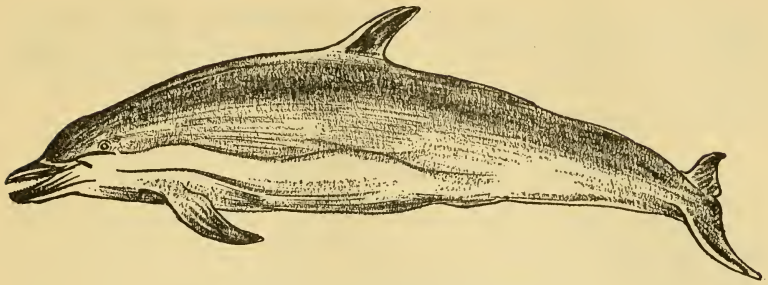

Fig. 54—*Common Dolphin*

The Long-beaked Dolphin (*Steno*) has a beak even longer than the common dolphin and distinctly marked off from the forehead. The teeth, twenty to twenty-seven in number, are heavier than in the common dolphin and are roughened or furrowed. The upperparts are blackish or deep gray, while the underside is white. This slender species measures about eight feet in length. The long-beaked dolphin is recorded from the Malay Archipelago, but not elsewhere in the East Indies.

The Slender Dolphins (*Prodelphinus*) are shaped like the long-beaked dolphin but the teeth, which number thirty-nine pairs in each jaw, are smooth. They differ from the common dolphin (*Delphinus*) in having the palate flat, without the deep grooves inside the toothrows found in that species. The slender dolphin of the waters of the East Indies is ashy gray. It is about six feet long. It may reach Japanese waters, but the limits of its range are not known.

The White Dolphins (*Sotalia*) of the Malay waters and Chinese coast have long beaks; the flippers are broad at the base and have the posterior margin concave. The Malay species is glossy white with gray dappling and has about thirty-seven teeth in each row. The Chinese species may occur off Formosa. It is milky white, with pinkish fins, and has thirty-two teeth on each side above and below. A slaty-colored species, sometimes called the lead-colored or plumbeous dolphin (*S. plumbea*), is distinguished by its very long snout; from the tip of the snout

to the eye is about one-sixth of the body length, which is about eight feet. The number of teeth is about thirty-five on either side above and below. It is found from India to the Straits of Malacca.

Dugongs, Sea Cows. Order Sirenia

The sea cows, manatees, and dugongs are mammals which have undergone almost as much change to fit them for an aquatic life as have the whales. Their hind limbs have disappeared, their fore limbs are now flippers, their tails have expanded into flukes. In some of their features they resemble the elephants. The upper incisors when present have developed into tusks. The cheek-teeth come into place from the back of the toothrow, pushing the others forward as they wear.

Dugong. Family Dugongidæ

The Dugong (*Dugong dugong*) is the only representative of this family. This animal has a crescent-shaped tail. The upper incisors of the males are enlarged to form small tusks; in the female these are yet smaller and do not pierce the gum.

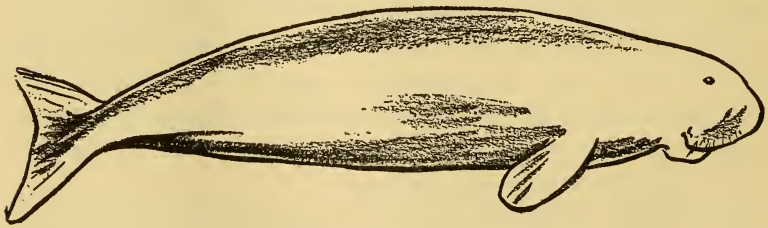

Fig. 55—*Dugong*

In color, the dugong is uniform bluish gray, sometimes lighter on the underside. It may be as much as nine feet in length although it is generally smaller. The dugong feeds on seaweeds and other aquatic vegetation and lives in shallow bays and estuaries from the Red Sea through the Indian Ocean and east as far as the Solomon and Marshall Islands. It extends south

to northern Australia and north to the island of Amami Oshima, Luchu Islands.

Sea Cows. Family Hydrodamalidæ

The family Hydrodamalidæ contains but one animal, the extinct **Northern or Steller's Sea Cow** (*Hydrodamalis stelleri*). It was the largest of any of the Sirenia, reaching a length of twenty-five to thirty feet. The sea cow was found only on Copper and Bering Islands, off Kamchatka in the Bering Sea. It was discovered by the explorer Behring in 1741 when he was shipwrecked on the island which now bears his name. At that time, the animal was abundant in the bays, but being large and stupid, was so easily killed that in about twenty-five years after its discovery the species had been exterminated. Occasional bones are still found on these islands.

Elephants. Order Proboscidea. Family Elephantidæ

The elephants of the present day are found only in Asia and Africa. The African elephant is now put in a separate genus.

The Asiatic Elephant (*Elephas maximus*) inhabits the forested areas of India, Ceylon, Burma, Indo-China, Thailand, Malaya, Sumatra, and a small section of northern Borneo. It is believed that the elephant was brought to Borneo by man and has again reverted to the wild state. The Indian elephant has been domesticated for centuries. The bulls carry tusks of appreciable size; the females have very short ones that do not protrude beyond the lips. The molar teeth of most mammals, erupted successively, stand one behind the other in the jaw. The enormous molars of elephants behave instead much as though they were attached to the rim of a wheel. Each tooth, as it moves fully into place, is subjected to great wear by the tooth opposing it. It continues to move forward in the jaw. When its successor is fully in place, the former one, worn down to the roots, is shed. It is common to see in an elephant's jaw

one complete functioning molar, with a worn-out portion of its predecessor in front of it and a portion of the crown of the molar behind it just beginning to show wear.

The male Indian elephant seldom exceeds the height of nine feet; the female is about a foot less. The age to which an elephant may live is often greatly exaggerated. The oldest authen-

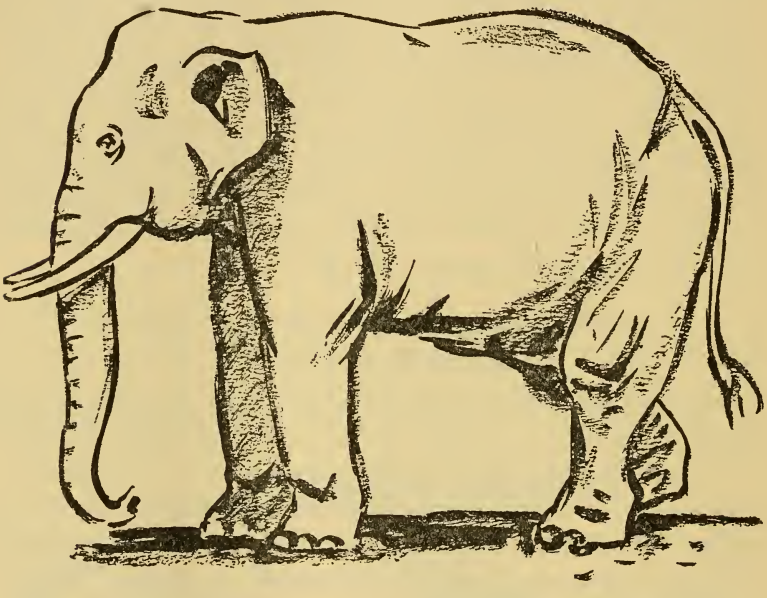

Fig. 56—*Asiatic Elephant*

tic record is about eighty years; an elephant of fifty may be regarded as old. It is now reasonably well proved that the greatest span of an elephant's life is less than that of a man.

The female elephants carry their young from eighteen to twenty-two months before birth. The newborn calf is about three feet high and weighs about two hundred pounds. At this time the trunk is short, not very flexible, and is not used in suckling.

Elephants feed entirely on vegetable matter and consume

great quantities of it—above a quarter-ton of hay in captivity daily. They live in herds composed of thirty or forty or more individuals of various sizes and of both sexes. Adult individuals occasionally become dangerous. Such elephants, generally males living alone, are known as "rogues."

The elephant of Sumatra has been considered a subspecies of the Indian elephant on account of its slimmer build and the smaller size or even absence of tusks in the male.

Even-toed Ungulates. Order Artiodactyla

This order contains the cattle, sheep, goats, goat-antelopes, deer, and pigs.

Hollow-horned Ungulates. Family Bovidæ

The Bovidæ (cattle, sheep, goats, and relatives) are characterized by true horns growing upon bony cores arising from the frontal bones of the skulls. These horns are never shed during life, and in the majority of species both sexes carry them. After death the horn is easily removed from the core. The old-fashioned powder horn is a good example of this horn sheath.

The Banting or Wild Ox (*Bibos sondaicus*) is found in Burma, the Malay Peninsula, Siam, Borneo, Java, and Bali. The form found in Java and Borneo differs from the Burmese banting in that the bulls, as they grow older, become blackish brown or almost black. Young bulls, depending on their age, vary from bright red-brown like the cows to dark chocolate. The bull banting of Burma, on the contrary, seldom gets darker than chestnut color. All specimens have a large white rump-patch and white legs. Bantings generally go about in small parties, although solitary bulls—old animals driven from the herds—are also frequently met. Even when wounded, bantings are seldom dangerous. The record spread of the horns of the Burmese banting is thirty-four and one-half inches; that of the Javan form is twenty-six and one-half. Only domesticated bantings are known in Bali.

The Asiatic Water Buffalo or Indian Buffalo (*Bubalus bubalus*) is easily recognized by its great size—five feet or more at the shoulder—and by its large horns, which rise from the side of the head and sweep backward in a circular manner. In some specimens these horns are long and massive, the record length being seventy-seven and three-eighths inches. The wild Asiatic water buffalo is now restricted to northeastern India, Ceylon,

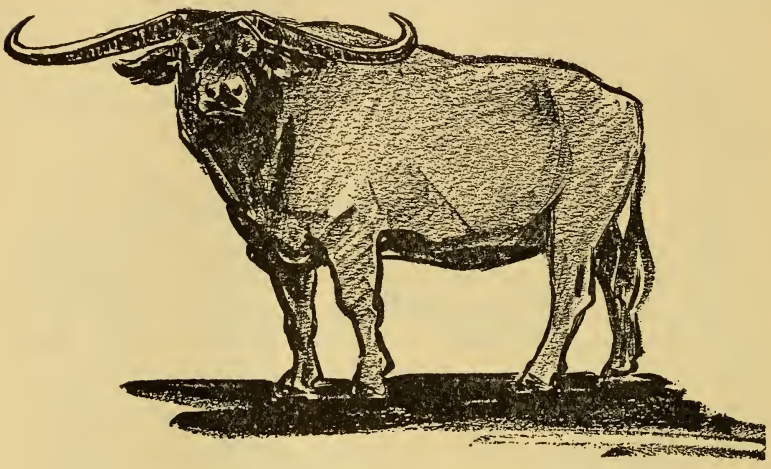

Fig. 57—*Asiatic Water Buffalo*

southern Indo-China, and the Malay Peninsula. This buffalo has been domesticated for centuries and has been introduced into southern Europe, northern Africa, China, and the Philippines (where it is known as the carabao), and many of the islands of the far east, including Australia. In many parts of this territory herds have reverted to a semiwild condition, so that in sections where the wild animal is still found, it is difficult to tell which are the typical wild animals and which are feral. In northwestern Borneo, buffaloes (*Bubalus b. hosei*) inhabiting certain river valleys are small and have shorter horns; they are believed to be indigenous. In the wild state, the Asiatic buffaloes inhabit dense reed beds and high grass and are never found far

from water. They generally go about in herds of considerable size. Buffalo are considered dangerous game to hunt, not only on account of the thick cover which they inhabit but because they are more inclined to charge than any of the other wild cattle. Some have been known to watch their back trail when they sense that they are being followed, and from a concealed place to charge the tracker without warning.

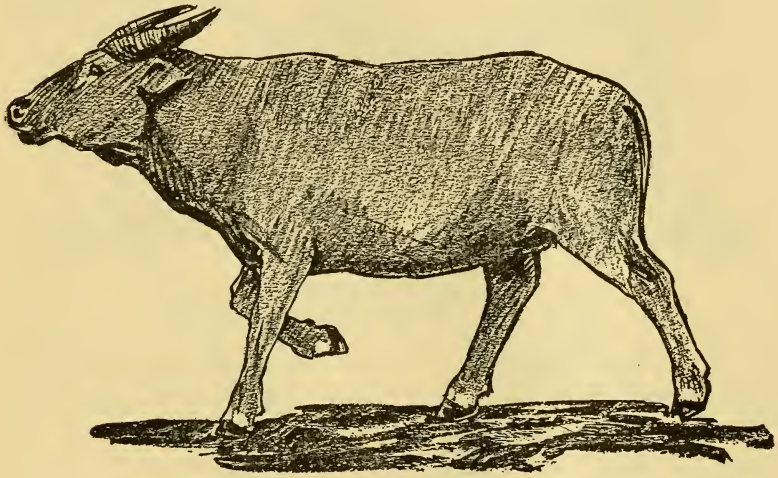

Fig. 58—*Tamarau*

The Tamarau (*Bubalus mindorensis*), a distinct small buffalo, is found on the island of Mindoro, in the southern Philippines. This buffalo is less than four feet at the shoulder and has short stout horns. A horn twenty inches long is a good size. Tamarau are dark brown or grayish black, and have more hair on their bodies than water buffaloes. They frequent thick marshes along the rivers and it is said that they also inhabit the mountain forests to an altitude of over six thousand feet where they live in thick bamboo jungle.

The Anoa or Pygmy Buffalo (*Anoa depressicornis*) is a native of Celebes. It is the smallest of the wild cattle, being

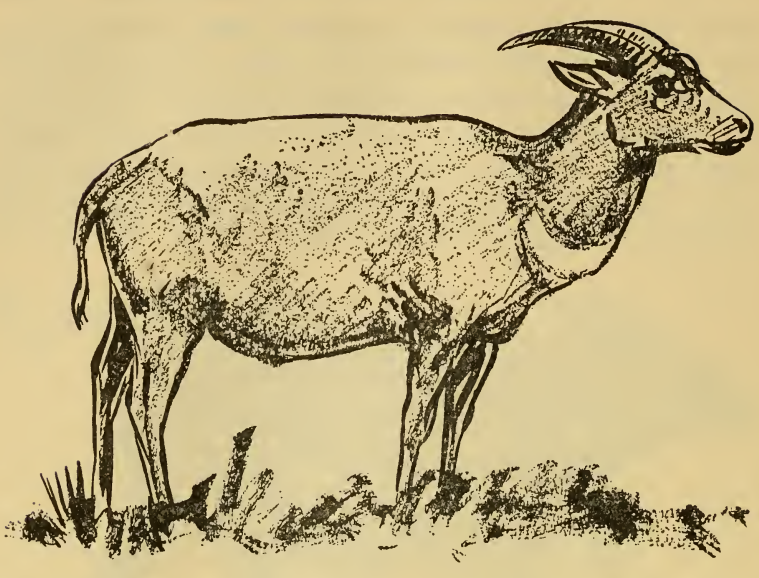

Fig. 59—*Anoa*

about three feet four inches high. It has shorter, straighter horns than its relatives, the record length of one horn being fifteen and three-eighths inches. Young animals have a coat of light brown hair which darkens as they reach maturity. In the adult the hair may be very dark brown or black. Very little appears to be known about the habits of this animal. It is said to live in pairs rather than in herds, as is the case with other buffalo, and to frequent wooded districts on mountain-sides. Like other buffalo, it is partial to water.

The Serow (*Capricornis sumatraensis*) is a member of the group of animals known as the goat-antelopes. It shows a marked resemblance to its ally the Rocky Mountain goat of North America, except that its color, instead of being white like the mountain goat, is black or blackish gray, with a grizzled appearance. The long coarse hair is lengthened along the back. The legs are brown. The black horns, generally sharp-pointed, grow nine or ten inches long. The two sexes are very

similar. The serow stands about three feet high. It prefers to live on the steep forested areas along the mountain-sides and is found in the mountainous sections of southeastern Asia from China south to Sumatra. A much smaller, grayer species, with

Fig. 60—*Serow*

longer hair (*Capricornis crispus*) is found in Japan, and Swinhoe's serow (*Capricornis swinhoei*), a close relative of the Japanese serow, occurs in Formosa.

The Chamois (*Rupicapra rupicapra*) has been introduced from Austria on Mount Wakefield in New Zealand. It is another member of the goat-antelope group but it differs by the fact that its horn tips curve backward and down.

The Himalayan Tahr (*Hemitragus jemlaicus*) is a native of North India and has been introduced into the Mount Cook district of New Zealand. The tahr is a short-horned goat noted for its luxuriant coat of long brown hair.

The Bharal or Blue Sheep (*Pseudois nahura*), a native of Tibet and west China, has also been introduced into the Mount Cook district of New Zealand. The horns of the bharal ram are distinctive; they first curve outward and then down and backward from the sides of the head. The color is bluish gray, the underparts and legs handsomely marked with black and white.

Deer. Family Cervidæ

The deer are characterized by solid bony antlers, sometimes miscalled horns, which are generally worn by the male. A few kinds of deer lack antlers; in one group, the caribou and reindeer (*Rangifer*), the female also grows antlers. The antlers are shed and regrown periodically.

Many authors restrict use of the name *Cervus* to the red deer of Europe and Asia and to the wapiti of Asia and North America. Others include in *Cervus* all the deer of this general type. The latter system is followed here for the sake of simplicity. Deer of the Sambar group (subgenus *Rusa*) are found from China and Formosa, India and Ceylon, throughout the Malayan region to the Moluccas and Timor. Sambar have been introduced on New Caledonia, New Guinea, and other islands. These deer are medium to large and their antlers have two tines growing from the main beam, making three points on each antler. Sambar (*Cervus unicolor*) has been divided into numerous subspecies. On Sumatra and the islands along the east coast the Malayan sambar (*equinus*) occurs. This is a large dark deer about four and one-half feet high and is the form found on the nearby mainland. In Borneo, Billiton, Banka, and some of the islands of the Bornean coast sambars (*brookei*) are smaller and darker. The sambar from Java, east throughout the Lesser Sundas to Timor, Celebes, and the Moluccas (*C.*

hippelaphus) is a smaller, lighter-colored animal with more slender horns, smaller ears, and thinner tail instead of the bushy tail of the typical sambar. These deer generally rank as a full species.

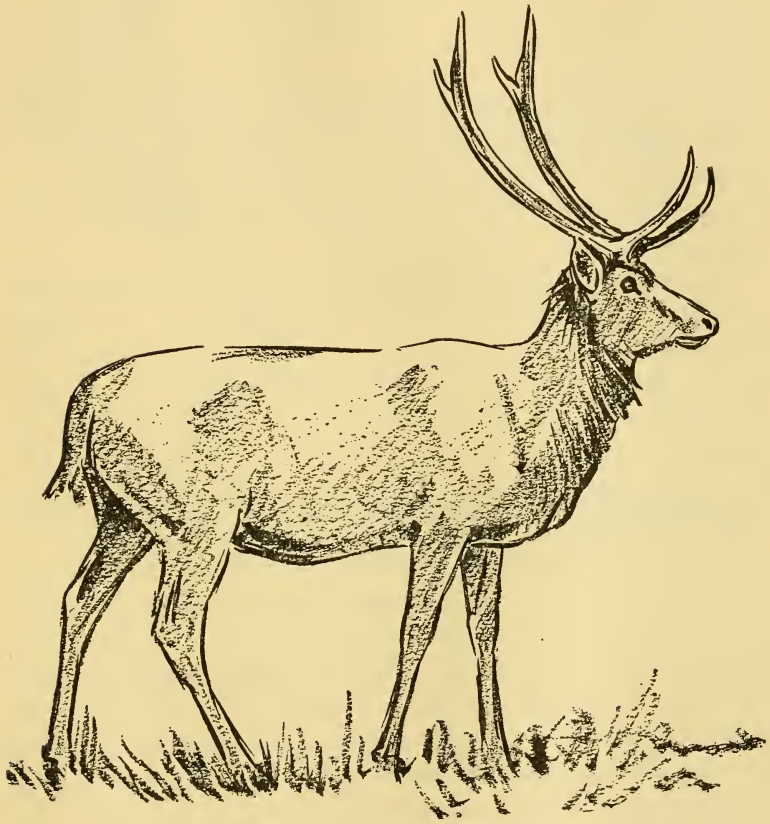

Fig. 61—*Sambar Deer*

On Bawean Island in the Java Sea, there is found a small deer only about twenty-seven inches high and of a uniform brown color. **The Bawean Deer** (*Cervus kuhlii*) is found only on this island and is very rare in museum collections.

In the Philippine Islands are also a number of small deer of

the sambar group. The most colorful of these is **the Philippine Spotted Deer** (*Cervus alfredi*). Its general color is rich dark brown, distinctly marked at all seasons of the year with yellowish white spots. It is about twenty-eight inches at the shoulders. It is found on Cebu, Guimaras, Leyte, Masbate, Negros, Panay, and Samos. The Philippine deer (*philippinus*), found on the island of Luzon, is slightly larger than *alfredi* and is dark brown, darker on the back and lighter on the neck. Dark streaks from above each eye meet to form a band running down the center of the face. Other forms of the sambar group are found in the Philippines: Mindoro, Mindanao, Basilan, and Culion.

The Sika Deer (*Cervus nippon*) stands only about three feet in height. The antlers generally have four tines. In summer the reddish brown coat is covered with white spots, but in the darker brown winter coat these spots disappear or become very indistinct. The sika is found in northern China, Manchuria, Japan, Formosa, and the Luchu Islands (possibly introduced). The sika deer of Formosa retains the spots to some extent throughout the year.

Numerous deer have been introduced into various sections of New Zealand, namely: the European red deer (*Cervus elephus*), the axis deer (*Cervus axis*), the fallow deer (*Dama dama*), the sambar (*Cervus unicolor*), the sika deer (*Cervus nippon*), all from Europe and Asia; and the Virginia deer (*Odocoileus virginianus*), the mule deer (*Odocoileus hemionus*), the wapiti (*Cervus canadensis*), and the moose (*Alces americanus*) from North America. The axis deer has also been imported to some of the islands of Hawaii.

The Grant Caribou (*Rangifer granti*) inhabits the western end of the Alaskan Peninsula and Unimak Island of the Aleutians; the reindeer (*Rangifer tarandus*), Old World representative of this group, is found on Sakhalin. Caribou are large deer standing about fifty inches at the shoulder. The antlers are slightly palmated and are borne by both male and female.

Fig. 62—*Sika Deer*

The Barking Deer or Muntjac (*Muntiacus muntjak*) is a small red deer found chiefly in wooded areas or thick undergrowth. The males have small antlers which have but one short tine; these antlers grow at the tips of long skin-covered pedicles rising well above the skull. The males have large canine teeth protruding from the upper jaw. The voice shows a marked similarity to the sharp bark of a dog. The muntjac has an extensive range, from China and Formosa to Sumatra, Java, Bali, Borneo, and smaller islands. Throughout this range many different forms have been described.

The Musk Deer (*Moschus moschiferus*), is a small animal measuring about two feet at the shoulder. It is characterized

Fig. 63—*Barking Deer*

by the absence of antlers, by long upper canine teeth in the males, and by the abdominal gland which yields the musk of commerce. This musk gland, found only in males, is especially well developed during the mating season. The musk is colored dark brown and when fresh is soft and moist. After the death of the deer this secretion soon dries. The gland is cut out by the hunter and is tied up in a portion of the skin covering it. This is known as the "musk pod." A "pod" contains about one ounce of musk, which is of high commercial value.

The musk deer has heavy legs. The coarse, brittle hair is

dark brown, often mottled with gray or light brown spots. This deer is constantly being hunted and is slowly disappearing from many of the places where it was at one time common. It prefers mountain forests and is found in the Himalayas, Tibet, western China, Siberia, Manchuria, Korea, and Sakhalin.

Chevrotains or Mouse-deer. Family Tragulidæ

This family contains the chevrotains or mouse-deer of southern Asia and the water chevrotains of West Africa. They look like small antlerless deer. The males possess canine teeth. In some structures of their skulls and teeth they resemble the camels.

The Mouse-deer or Chevrotain (*Tragulus*), standing less than a foot high at the shoulders, is the smallest of the Asiatic hoofed animals. When seen running through the brush it reminds one of a rabbit. In fact, its external appearance and shape are much like those of a long-legged rodent, such as an agouti of South America. The name mouse-deer is misleading, for this animal is not closely related to the deer. The range extends throughout southeastern Asia to adjoining islands. Numerous forms have been described, all of which fall into two species, the larger mouse-deer (*Tragulus javanicus*) found on almost all of the Greater Sunda group of islands, and the smaller mouse-deer (*Tragulus kanchil*) found on Sumatra and some of its associated islands.

Pigs. Family Suidæ

Even the less familiar members of this family may be recognized by the elongated head and snout and the tusks which grow from both the upper and lower jaws. These tusks grow throughout life, those from the upper jaw curving upward. The hair is coarse and bristly, the tail generally fairly long and tufted on the end.

The Wild Pigs (*Sus*) have the greatest range of any of the larger mammals of the islands. Domestic pigs, taken from is-

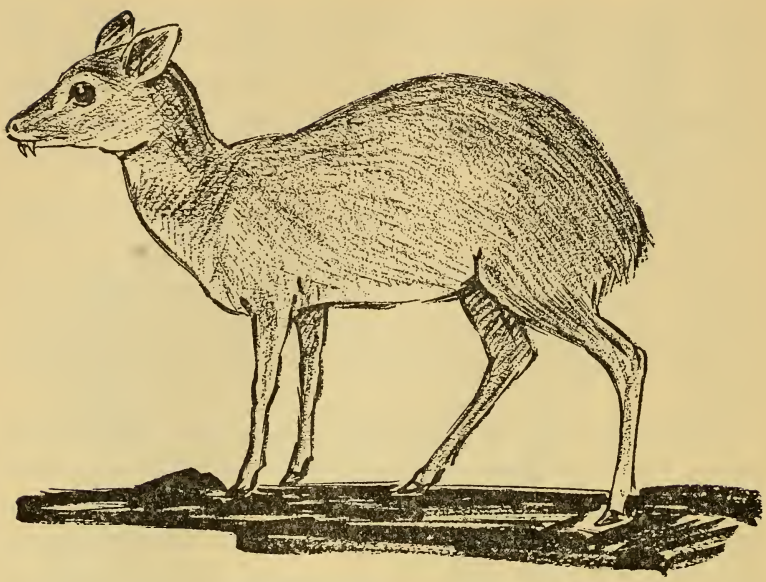

Fig. 64—*Mouse Deer*

land to island by man, have often reverted to the wild, which accounts for their presence on most of the inhabited Pacific islands. The common wild pig (*Sus cristatus*), found on the mainland of Asia, also occurs on Sumatra, Java, and many of the associated islands. In Japan, the Luchu Islands, and Formosa, the Japanese boar (*Sus leucomystax*) occurs. This animal has a white streak on its muzzle. The Javan pig (*Sus verrucosus*) is distinguished by the presence of three small warts on each side of its face. The bearded pig (*Sus barbatus*) is recognized by the long fringe of hair on the cheeks. It is found in Borneo, Sumatra, some of the smaller islands, and also on the Malay Peninsula. The giant pig (*Sus gargantua*) is known only from a skull from southeast Borneo. The Celebes pig (*Sus celebensis*) has warts on the face. It is related to the Javan pig (*Sus verrucosus*).

The Babirusa (*Babirussa babyrussa*) is a remarkable pig of Celebes and Buru. The males have very long tusks in the upper

and lower jaws that turn upward and backward in sweeping curves. The legs are long in comparison with other pigs. The babirusa of Buru has a well-developed grayish coat, while the Celebes form is very scantily haired.

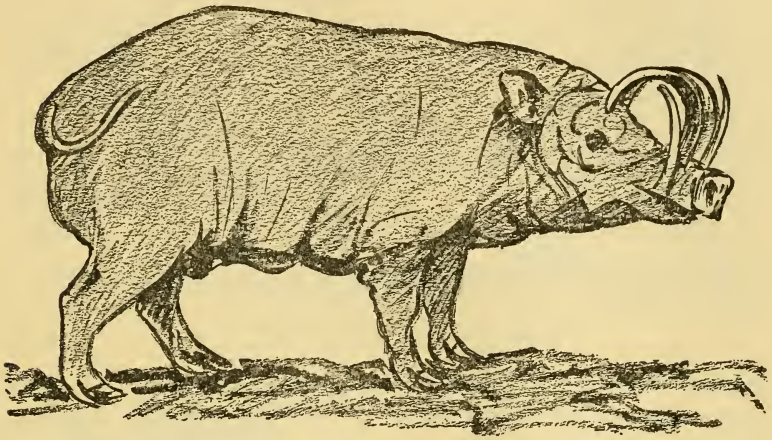

Fig. 65—*Babirusa*

Odd-toed Ungulates. Order Perissodactyla

This order contains those hoofed animals which have an odd number of toes, namely, horses, rhinoceroses, and tapirs. Only the rhinoceroses and tapirs are found within the East Indies.

Rhinoceroses. Family Rhinocerotidæ

The rhinoceroses are now found only in Africa and southern Asia. In Africa there are two kinds and in Asia three, two of which are found in our region.

The Javan Rhinoceros (*Rhinoceros sondaicus*) carries a single horn and looks very much like a small edition of the large Indian rhinoceros. It has deep folds in its thick, dusky gray skin. At one time this animal had a very extensive range, from eastern India, Burma, and Indo-China through Thailand and the Malay Peninsula to Sumatra and Java. It is now very rare everywhere and has become extinct in many parts of its

former habitat. It is still hunted by natives, chiefly because of the high prices paid for its carcass by the Chinese who use not

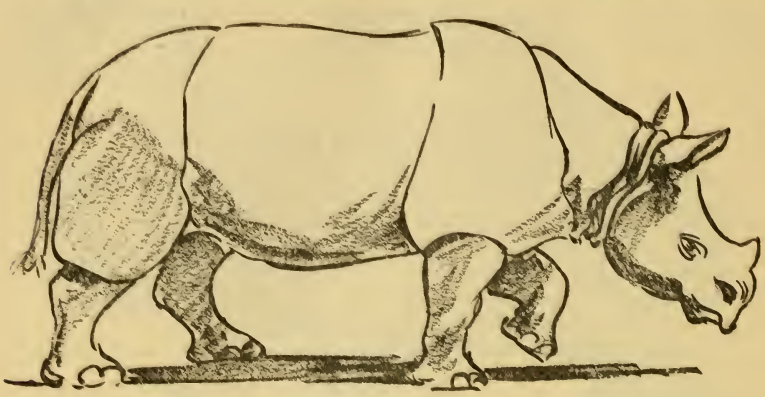

Fig. 66—*Javan Rhinoceros*

only the horn but the bones, blood, and other parts for medicine. This animal can be saved from extinction only by rigid

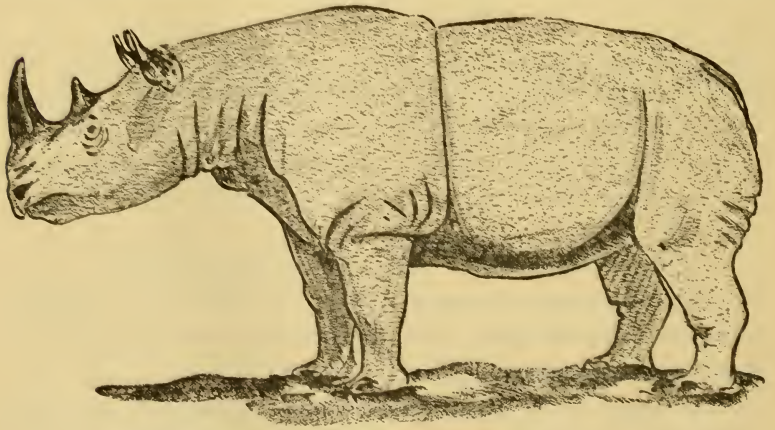

Fig. 67—*Sumatran Rhinoceros*

protection. The Javan rhinoceros lives in the forest. It stays near places where it can wallow and is found both in the swampy lowlands and as high as seven thousand feet in the mountains.

The Sumatran Rhinoceros (*Rhinoceros sumatranus*) is the smallest of the family and also the most hairy, especially when young. This rhinoceros carries two horns, and the folds of the brownish black skin are much less marked. On the mainland it has much the same range as the Javan rhinoceros; on the islands it occurs in Sumatra and Borneo but not in Java. Its habits are very similar to those of the Javan rhinoceros but it prefers the thickest of forest jungle on rough mountainsides. Mud wallows are necessary for the health of this animal, and when found they are a sure indication that rhinoceros are in the vicinity. Like the Javan rhinoceros it has been persistently hunted for its horns and blood, used as medicine by the Chinese, and consequently it is no longer found over much of the country where it once existed. It also is doomed to extinction unless adequate protection is given it.

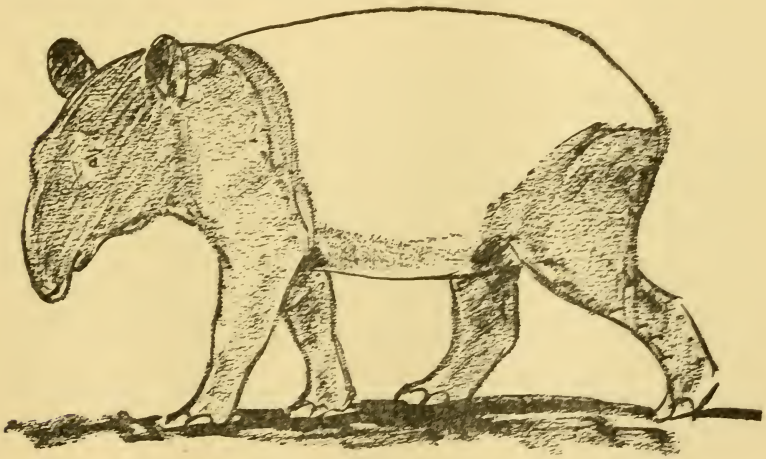

Fig. 68—*Malay Tapir*

Tapirs. Family Tapiridæ

This family includes the Old World and New World tapirs. The New World tapirs are found in Central and South America while in the Old World the single species is found from

Tenasserim south through the Malay Peninsula to Sumatra.

The Malay Tapir (*Tapirus indicus*) is easily recognized by its heavy build, short tail, oval ears, and long snout or proboscis. The head, fore parts, and hind legs are black; the remainder of the rump and the upperpart of the thighs is grayish white. The young at birth are brownish black with spots and streaks of brownish yellow on the back and sides, but they change to the adult color during their first year. An adult may reach the height of three and one-half feet. Tapirs frequent forests; they live chiefly in swamps and along rivers and are very partial to water. In their native home they are shy and difficult to approach, but in captivity they become very tame.

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3

Distribution of Mammals in the Pacific Area

The reason for the presence of certain kinds of mammals on one island group, for their absence from another, or the substitution of still other kinds of animals on a third island, must be sought in the interweaving histories of the evolution of the mammals themselves and in the evolution of the topography, climate, vegetation, and other components of their environments.

ORIGIN AND EVOLUTION OF MAMMALS

The earliest, most primitive mammals are lineal descendants of peculiar reptile-like creatures whose fossil remains have been found in South Africa and elsewhere. Those first mammals imperceptibly and during the course of very many generations developed away from being actual reptiles. Gradually those basic distinctions by which every mammal today is distinguished from every reptile took form: heat-conserving and regulating mechanisms including hair, sweat glands, special automatic nervous control of the oxidizing processes were progressively developed; milk glands, together with the change from egg-laying to bearing of young, were evolved; alterations took place in the forms and functions of certain bones and muscles adjoining the head and the hinged part of the jaw. During an immensely long period of time these alterations of body parts into different shapes and for new purposes took place; the descendants of reptiles became mammals.

Those dawn mammals were unlike any living mammals today.

The few fragmentary fossils known indicate that some, at least, were rat-sized creatures, with pointed teeth suitable for eating insects. Yet from those animals or others somewhat like them began not only the genealogical lines leading to the principal modern Orders, but a host of other lines which, figuratively speaking, experimented with themselves for longer or shorter periods of time, and, finding themselves inadequate, died out. The few successful ones became the ancestors of our earliest carnivores, insectivores, bats, hoofed animals, rodents, marsupials, and monotremes. Such relatively modern groups alone concern us here.

That process, involving change of shape and size combined with change of use of parts, has remained continuously operative. The primitive five-toed horse progressively lost its outer toes and became one-toed. Thus during millions of years or even millions of generations a little five-toed mammal gave rise to a large, one-toed horse. At the same time the remaining toes increased in size and strength in order to sustain the weight of the body, for horses were growing bigger. Innumerable other changes in the many parts of all animals, which fitted them for the performance of diverse functions, took place continuously everywhere. This process is generally termed evolution.

EVOLUTION OF ENVIRONMENTS

Throughout this length of time, when the characteristics of mammals were changing, alterations were taking place also in the earth itself. Slow movements of the earth's crust raised or lowered parts of the surface. Near the sea, uplifts pushed back the ocean and caused islands long separate from the mainland to become joined to it; or downwarping permitted the waters to flood the land and to convert high ground near the coast into islands. On the continents long-continued earth movements elevated mountain ranges, diverted rivers, or established new rain-collecting areas.

The slowly changing shapes of the land and oceans simulta-

neously brought about slowly changing climates. The draining of shallow seas had modifying effects on the temperature and moisture of the air above and around them. The elevation of large mountain ranges, particularly if directed north and south, not only produced colder climates on their own slopes and crests but by altering prevailing winds modified profoundly the rainfall and temperature of the lowlands on either side. The reverse of these processes also took place: The heights of other mountain ranges already elevated were gradually reduced by weathering and erosion, again with the effect of modifying local climates. Such changes take place on islands as well as on continents.

From time to time during the earth's history periods of lower temperatures have, by cumulative effect, resulted in "ice ages," when vast amounts of water from the oceans slowly accumulated as snow or ice at or near the earth's poles. Those huge polar ice-caps—smaller ones exist today on Greenland and Antarctica—had, at their greatest development, pronounced climatic effects on the regions near them. The grinding movement of the ice also caused important local changes in the rocks and soils which it overspread.

The climate affects mammals largely indirectly, through its effect on vegetation. Damp climates favor forests, relatively dry climates lead to spread of grasslands, while desert climates result in the development of leafless water-storing plants which often produce great quantities of seeds after the occasional rains. Few mammals live with equal advantage in these various climates; in all environments there are species suited to the special conditions of food and shelter. The presence of these is an important factor in keeping out the less well adapted species.

CONTINENTAL AND OCEANIC ISLANDS

Two classes of islands are commonly recognized. Continental islands are those which stand on the continental shelf, sepa-

rated by relatively shallow seas or straits from the mainland and connected with it at various times in the history of the earth. Oceanic islands have never been connected with a continent but are separated from it by water of great depth—more than six hundred feet. They have arisen from the floor of the ocean. In a few cases it is uncertain whether certain islands are continental or oceanic, whether the former connections with the mainland have foundered or whether the island has been pushed up from the bottom of the sea.

Examples of continental islands are the Greater Sundas—Sumatra, Java and Borneo—Japan and Formosa, formerly connected with continental Asia. Similarly, New Guinea was once joined to Australia. The shallow seas now separating such islands from their mainlands were probably dry land during the last ice age. Many mammals which occurred in neighboring areas of the continents were able to spread to the islands without difficulty. At the end of the ice age the gradually rising seas again isolated the islands with the animals which had invaded them. The mammals inhabiting continental islands differ only slightly or not at all from those of the nearby continents; ancient types of animals, known as "living fossils," are usually absent.

The Luchu and Kurile Islands seem to represent parts of former continental areas that sank. The higher peaks of former coastal ranges were left as islands, cut off from each other and Japan, Formosa, and Kamchatka by deep straits. Movements of the earth's crust have also thrown up great interior mountain ranges on land; in some cases these ridges continue out onto the floor of the ocean. Such plunging mountain ranges as the Aleutians occur, the landward members of which are continental, but the distant peaks have always been separated by deep straits from the mainland.

Celebes, the Moluccas, the Philippines, and Australia may have been parts of an ancient southeastern extension of the Asiatic continent. If this be true, this area must have been

broken up in the Age of Reptiles or not later than very early in the Age of Mammals, a hundred million years ago. No indication of such a continental origin of these islands is to be found in the mammals of this area. Similarly, New Zealand has been supposed by some to have been separated from Australia by the sinking of the great area now covered by the Tasman Sea.

Oceanic islands, built up from the bottom of the ocean, are of several kinds. Just as on land, the crust of the earth covered by the oceans may be wrinkled and folded. Great underwater ranges of mountains are known, the highest points of which project above the water. In the case of New Caledonia and probably New Zealand, the projecting mountain-tops form large islands and reach high above the ocean level. Other islands are volcanoes, built up by great eruption from the depths. Combinations of mountain range and volcano may explain the arc-like chains of islands, such as that formed by the Palaus, Marianas, and Bonin Islands. Another such arc includes the Solomons and New Hebrides, while the Marshalls, Gilberts, and Ellice Islands suggest a third. If Celebes, the Moluccas, and the Philippines are not remains of an ancient continental mass, they may well be ridges pushed up from the ocean floor. The first two seem to have been revolved like a vast eddy between the masses of southeastern Asia and Australia. Great disturbances of the earth's crust must have occurred in this region; certain parts have been heaved up, others have sunk.

Coral barrier reefs and coral atolls are built on and around volcanic bases throughout the tropical Pacific. In some cases their peculiar shapes are explained by the gradual sinking of the heavy volcanic islands around which they formed. In other cases the change of sea level during the ice age may have been important.

Oceanic islands, even if situated near the continent, harbor relatively few mammals; but then, their nearness to the mainland is important if winds and water currents are likely to bring them drifting organisms. Often ancient types, "living

fossils" today, reached favorably situated islands in the distant past. A few bats and hardy, raft-riding mammals often are found on such islands. The remote Pacific islands had no mammals at all until the first men landed.

RANGE AND DISPERSAL OF MAMMALS

At all times during the history of the evolution of a species of mammals its environmental conditions have necessarily been generally favorable. For although the environment *best* suited to a species probably can never exist, neither can markedly unfavorable conditions be long sustained. Similar or even more favorable locations elsewhere may remain unoccupied by that species only because of intervening environmental barriers.

Favorable conjunction of animal needs with suitable surroundings may be temporary only. The animal is continuously evolving; the physiography, climate, and vegetation of its habitat are constantly changing. Let us assume a possible case, under which the surface of the land becomes lower, the climate hotter and drier, the character of the vegetation more and more desert-like. Simultaneously with this environmental change, involuntary evolutionary experiments are being conducted by the animal. Some of the products of variation are more suited to the drying habitat, others to a region even more humid than the original one. The former persist and reproduce their kind; the latter die. Thus an animal species has changed, and, through the selective action of a changing habitat, the changed species survives as a race distinct from the original one.

In a second situation, the environmental conditions at the margin of the range of a particular species of mammal gradually become favorably modified; what before was desert becomes grassland or forest, favorable to the species. Then, the species as a whole can advance, generation by generation, into the now favorable area until stopped by some new barrier. Ad-

vances of such nature are likely to be shared by all the animals of a region.

The ways in which mammal species and mammal faunas move from their favorable original environment into some newly available but just as favorable one, seem almost analogous to the creeping expansion of pools of water here or there on a dry, nearly level floor. This analogy is useful, provided that one remembers that the water (a fauna) is a solution of many liquids (species) which are slowly changing into other liquids, sometimes meeting and dissolving or obliterating still others, and that the floor itself and the local climate above it are also gradually changing.

Geographical movements of species depend fundamentally upon random movements of individuals through successive generations. Several deer, for example, born at locality "A," move fifty miles to the northeast and produce offspring at "B." If this takes place within the established range of the species it has little significance, but if it represents penetration into new territory for that species, perhaps repeated a thousand times along the perimeter of the range, it may well have significance. Such movements, generation by generation, represent the way by which land animals spread into favorable environments. This procedure continues until stopped by contact with unfavorable conditions. But random movement into and accidental transportation into the unfavorable environment persists. Rarely accident permits passage through a barrier into favorable conditions.

THE PASSAGE OF NATURAL BARRIERS

Barriers to the spread of animals on the continents are sometimes incomplete because not sufficiently extensive, or are completely efficacious against one species while scarcely hindering another. The functioning of a barrier may vary with the season of the year, or perhaps with sun-spot cycles. In the course of

geological time, as has been indicated, some barriers develop, and others disappear. Barriers have been spoken of as chiefly climatic or physiographical but others based upon disease, competition with other species, and physiology also occur. All are likely to be by-passed or penetrated sooner or later through temporarily favorable circumstances or because of permanent modification of the affected organisms.

Even when barriers seem to be complete, as at the edges of wide oceans, accident or the laws of chance eventually permit occasional species to cross to other land masses or to islands. Wherever land and sea meet, animals have repeatedly—not once or twice, but thousands of times during the passage of time—fallen into or been forced into the waters. Trees with climbing mammals clinging to their branches or living in hollows in their trunks fall into rivers and are carried out to sea. Ground-living creatures are sometimes accidentally taken for rides when banks cave in. The debris from such undermined banks and tangled masses of tree-trunks and water weeds sometimes forms extensive rafts. Bats, especially those that migrate, may be blown out to sea by storms. If the distance across a water barrier is short, some of the larger mammals may even swim across; deer and pigs possibly do this. Natural swimmers, such as otters, can be carried by flooded rivers into the ocean but are likely to swim back to the nearby shore.

The natural rafts mentioned above have been one of the commonest means of transportation across seas. Trees and masses of vegetation become undermined by rivers during the rainy season and are carried out to sea. In the East Indies, where the currents between the innumerable islands are changeable, such rafts have good chances to be stranded quickly, but in the open ocean the arrival of one at a remote island must indeed be a rare occurrence. The mammals so transported are likely to be small, tree-living species, and the raft must be large enough and carry sufficient food to preserve life until the accidental landfall is made.

ESTABLISHMENT OF SPECIES ON ISLANDS

Few of those surviving species are able to establish themselves permanently. The reason for this is that the new environment must not only be favorable and provide approximately the kind of climate and the kind of food the animal needs, but the newcomer must either arrive at the same time as one of its opposite sex or be a pregnant female in order that the process of colonization of the island may begin. It is not surprising then that the species of animals on all islands except those near mainlands are few and assorted. A few mammals have traveled as accidental "hitch-hikers" on native canoes and on the ships of explorers, traders, and whalers. Several species of rats have by this means spread to almost all parts of the world, including even the most isolated islands. Domestic animals that escape and go wild also add island species. The game animals of various lands have been introduced, especially into New Zealand where they flourish.

More species are found on large islands than small ones. This is not merely because of the larger size of those islands but especially because, offering a far wider choice of habitat, they are likely to meet the requirements of specialized kinds of mammals. Almost continuous invasion by random drift may be imagined on islands which are favorably situated. However, very small populations anywhere are liable to extermination, and island populations are usually small. Large mammals are especially liable to this risk. On a small island their numbers are so limited that disease, an unfavorable year, or hunting by human inhabitants may kill them all. The fauna of an island may thus have formerly included species that were unable to persist.

ARCHAIC MAMMALS PRESERVED ON ISLANDS

Some of the ancient types of animals found upon deep-sea islands are the altered descendants of colonizers which must

have succeeded in establishing themselves when the world of mammals was comparatively young. The classical example of these is the pouch-bearing mammals of Australia. This land, even though called a "continent" because of its large size, is in reality a big, deep-sea island. Marsupials were present in America, Europe, and probably Asia at the time when they are believed to have reached Australia. Upon arrival they found a fertile and varied territory probably devoid of mammalian competitors. In their evolutionary experiments they produced pouched replicas of flying squirrels and tree squirrels, mice, lemurs, woodchucks, weasels, wolves, and moles. They failed to develop either a marsupial bat or a marsupial swimmer.

During the late prehuman and possibly early human period of Australia, many giant marsupials, which apparently died out rather recently, still existed. Huge hippopotamus-like animals, a marsupial "lion" (which probably ate vegetation), and enormous kangaroos have left their bones in caves and in the mud of dried-up lakes in Australia. New Guinea, representing the tropical phase of the Australian fauna, has much the same type of animals.

Archaic animals of other islands are by contrast less arresting. It is unlikely that any other islands contain mammals whose time of arrival dates as far back as the marsupial movement. Random colonization of islands has been a continuous process, and many animals that are not "recent" in terms of existing continental forms can still be found on islands. Such are the peculiar small cattle of the Philippines and Celebes, the pig-like babirusa and the black ape of Celebes. Similarly, many kinds of rat-like animals on those islands and also on New Guinea and Australia no longer possess close relatives in Asia.

BIOLOGICAL REGIONS

The land surface of the globe is divided into five major zoogeographical regions, which include a number of subregions.

The northern region, comprising Europe, northern Asia, and North America, is called the Holarctic Region. The several land masses which project from it are respectively named the Neotropical or South American Region, the Ethiopian or African Region, and the Oriental or South Asiatic Region. The

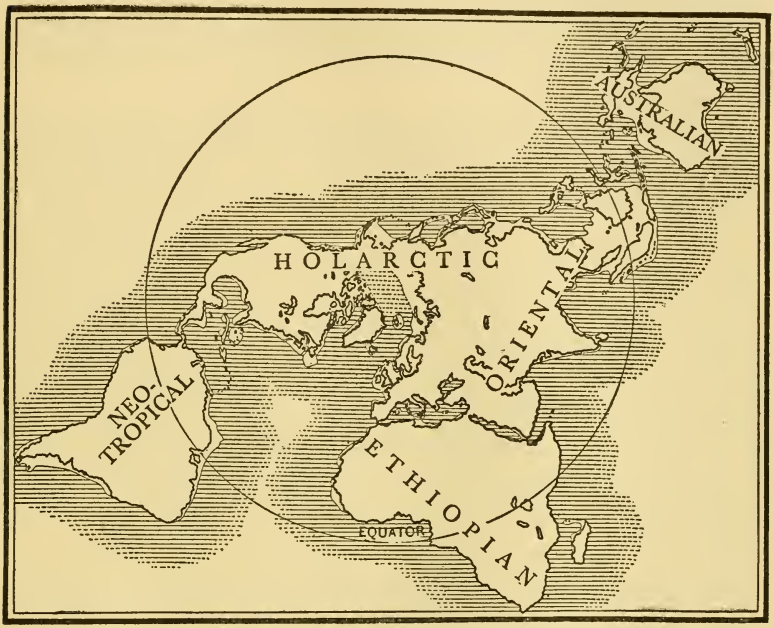

Fig. 69—*Faunal Regions of the World, showing probable greatest extent of land during the Ice Age (unshaded areas beyond coast lines)*

isolated Australian continent together with New Guinea forms the fifth, the Australian Region. This relationship of the faunal regions is indicated by a map (Fig. 69).

Some of these regions are divided into two or more subregions; for example, the Holarctic consists of the Nearctic or North American, and the Palearctic or Eurasian Subregions. The boundaries of these regions and subregions, unlike those of political areas, are not definite, for animals go wherever they

are not stopped by impassable barriers or prevented by other species.

The zoological regions or subregions which are related to the Pacific and East Indian area comprise parts of the cold Palearctic or Eurasian (northeastern Asia) and Nearctic (Alaska), a part of the warm Oriental (southeastern Asia), the Australian (Australia, New Guinea, and the Solomon Islands), and the Neotropical (limited to a few strays from Central and South America).

An important if anomalous area containing faunas of mixed archaic and "modern" mammals lies between the tropical Oriental and Australian Regions. This area, because its fauna is chiefly Asiatic in origin and contains few animals derived from Australia, can well be regarded as a subregion of the Oriental region. It includes four principal island groups, each of which is to some extent faunistically distinct: the Philippines, Celebes, the Moluccas, and the Lesser Sunda Islands. It has been variously named the Indo-Australian Subregion, the Australo-Oriental Subregion, and Wallacea, named for one of its early explorers, Alfred Russell Wallace. New Guinea, with the Solomon Islands, is held to be a subregion of the Australian Region.

The "subregions" of the open Pacific, the Polynesian, Micronesian, and Melanesian Subregions, are ethnological rather than biological conceptions. Their limited faunas are derived from one or other of the biotic regions of the adjoining continents.

FAUNAS OF THE PACIFIC ISLANDS

Numerous different kinds of animals, as shown beyond in the geographical index, inhabit the various groups of islands of the Pacific. It has been pointed out that the ancestors of animals living on islands came originally from the continents during the course of an almost unimaginably long period of time. Those continental sources, which have contributed very unequally to

the population of the islands, are three: Asia, America, and Australia. The last, though technically an island, is so large and has been occupied by its specialized marsupial fauna for so long a period that it is conveniently treated as a third continent. Asia, particularly the East Indies, has greatly out-distanced Australia and the Americas in providing faunal elements for the population of the islands. The Americas, on the contrary, have provided but a handful of land-dwelling species, most of these reaching islands rather near the American coast and only one of them going as far as Hawaii. A few representatives of the great evolutionary outburst of marsupials in Australia and New Guinea have reached Talaut, Celebes, the easternmost Lesser Sundas, and the Solomons.

The Aleutian Islands, included in the Holarctic Region, have a mammal fauna that decreases from the Alaskan end of the chain westward. The first island, Unimak, separated from the Alaska Peninsula by a shallow, narrow strait, has almost all of the mammals that occur on the treeless part of the peninsula. Some species have not yet been recorded, but this is probably because of inadequate collecting. The islands west of Umnak, which is itself one hundred and forty miles west of Unimak, may have no native land mammals. Caribou, bear, Arctic fox, wolf, wolverine, mink, weasel, the Arctic hare, marmot, ground squirrel, lemming mouse and lemmings, and a water shrew (*Sorex*) may occur on the landward islands; these are all North American forms, but they have close relatives in northern Asia.

The Kurile Islands similarly have a limited mammal fauna, chiefly species common to both Old and New Worlds. The arctic fox, red fox, brown bear, pygmy weasel, red-toothed shrew, varying hare, and a mouse-eared bat are such forms, but the wood mouse and the long-eared bat (*Plecotus*) occur only in the Old World Palearctic Subregion.

Japan, too, has a fauna consisting chiefly of local forms of northern continental groups—various bats, bears, the red fox, wolf, varying hare, pika, chipmunk, meadow mouse or vole, and

red-backed mouse. Some are related to the Eurasian types: certain insectivorous bats, badger, otter, pigs, moles, dormouse, wood mouse, and tree squirrel. Still other mammals have their affinities with the South Asiatic animals; some of the bats, including a species of flying fox, the Asiatic black bear, the raccoon dog, sika deer, the serow (a goat-antelope), the water shrew, the Japanese monkey, and the flying squirrels are among these.

The Oriental Region is usually understood to include India, Burma, southern China, Indo-China, Siam, and the Malay Peninsula. It extends to the Luchus and Formosa, and from Sumatra east to the Moluccas. The islands between Lombok and Ceram form a debatable area—Wallacea or the Australo-Oriental Subregion—where palm civet, deer, and wild pigs of southern Asiatic types overlap with mammals of Australian relationships, like the phalangers. Only a single genus of the phalangers, however, extends west beyond the Moluccas; no marsupials are known from any of the Lesser Sunda Islands other than Timor and nearby Wetar. The origins of the poor faunas of this debatable area are chiefly the Oriental Region, at least as far as mammals are concerned.

The Luchus are inhabited by few kinds of mammals. The indigenous Oriental mammals comprise flying fox bats, a species of leaf-nosed bat, and one of the horseshoe bats (other bats are Eurasian species). The dugong, a sea cow, reaches this far north. Pigs and the house shrew probably came in with man. The Luchu hare, found only in these islands, seems to be a relict form related to extinct rabbits.

Formosa is better populated with mammals than the Luchus. Almost all are South Asiatic forms. A few with northern affinities, such as the wood mouse, which occur on the island, are also found in the Chinese fauna. Not all of the species of mammals living on the nearby mainland are found in Formosa. In some cases these mainland species may have reached their present home only after the island was cut off; in other cases the island

does not offer proper environmental conditions to attract or preserve these mammals.

The Formosa macaque monkey, although usually given specific rank, is closely related to the common rhesus of southern China. The Formosan hare, described as a species of *Lepus*, may be related to the coarse-haired rabbit of the Chinese coast (*Caprolagus*). The moles, shrews, ferret badger, yellow-throated marten, mink, otter, Asiatic black bear, civets, palm civets, mongoose, clouded leopard, fishing cat, leopard cat, scaly anteater, hedgehog, squirrels and flying squirrels, and rats are either local races of Chinese species or identical to the mammals on the mainland. Formosa may have been formerly connected with China; the depth of the strait is now about fifty fathoms.

The Philippine Islands, excluding Palawan, the Calamianes, and Balabac which belong to the Malayan Subregion, are often separated as a distinct subregion. Their mammal fauna seems to have been derived chiefly from Malayan sources. It becomes progressively poorer as one proceeds northward, while the forms peculiar to the islands are concentrated in Luzon and Mindanao. Rodents and bats are widespread and diversified. Shrews occur on all the islands. The long-tailed or crab-eating macaque monkey, the civet, palm civet, pigs, and a small sambar deer are also almost everywhere. Squirrels, tarsiers, and flying lemurs or caguans are found only on several of the more southern islands. The tamarau or Philippine native representative of the water buffalo, is found only on Mindoro; however, introduced domesticated buffaloes have in some instances gone wild on various islands of the group. The slow loris, tree shrew, and one of the gymnure insectivores reach Mindanao.

Palawan, although it does not have all the Malay mammals, has so many of them that it is placed with the Greater Sunda Islands in the Malay Subregion. It was part of the mainland and connected with Borneo in all probability during the Pleistocene, while the other Philippine Islands have always been either separated from the continent or were connected so long ago that

there is little evidence of this connection so far as the mammals are concerned.

The Malayan Subregion is characterized by two gymnures (rat-like insectivores), tree shrews, flying lemurs or caguans, a number of fruit bats (the short-nosed and certain of the long-tongued fruit bats), a false vampire, the slit-faced bat (*Nycteris*), naked free-tail bat (*Cheiromeles*), slow loris, crab-eating and pig-tailed macaques, a variety of leaf monkeys and gibbons (except the hoolock), small-clawed otter, linsang, binturong, marbled cat, several small flying squirrels, striped and long-nosed ground squirrels, pygmy squirrels, and the mouse-deer or chevrotain.

Virtually all of the mammals of the Malay Peninsula are found in Sumatra; only a few are lacking from Borneo and Java. Fossil evidence indicates that the fauna may have once been more uniform; remains of elephants and tapirs have been found in Java where they are now absent. Extinction may account for some cases of discontinuous distribution, such as those of the tiger and of the leopard. The tiger is absent from Borneo and the leopard is known only from Java and the Kangean Islands, but both are present on the Malay Peninsula. Sumatra, Java, Bali, Borneo, and Palawan are all on the Asiatic continental shelf, and were part of the mainland in the not very distant past.

The islands to the east and north (Celebes and Philippines) have been separated for a very long time, since early in the Age of Mammals at least. Islands, especially the smaller ones, offer little variety of habitats, so that even if they were connected with the mainland as a cape or peninsula, they would not have a large mammal fauna. On the other hand, isolation of small populations on islands may result sometimes in more rapid evolutionary change than would be possible in large areas in the case of a widespread population. Inbreeding of small populations may fix characters that otherwise would be swamped.

The Malayan fauna is closely allied to those of the Indian

and Chinese Subregions, but it lacks some of the northern elements present in each. On the Malay Peninsula there are likewise several forms that do not occur on any of the nearby islands; those elements are chiefly Indian or Chinese forms, such as the gaur, a large species of bamboo rat, several squirrels, the large Indian and Burma civets, and the stump-tailed macaque monkey.

Sumatra is populated by mammals closely related to those of the Malay Peninsula; a few Malay forms absent from the other islands are tapir, serow, brush-tailed porcupine, and the siamang gibbon. Faunal relationships between Sumatra and Borneo are close; the tana tree shrew, the tarsier, the orang, the thick-spined porcupine, and the whitish species of the Oriental squirrel are elements present on both islands but absent from the Malay Peninsula and Java. On the other hand, several mammals are common only to Java and Sumatra: the Java tree shrew, the mink-like Java weasel, and one of the shrew rats. A native rabbit or hare, short-eared and striped with black, is thought to be allied to the coarse-haired rabbits of the Himalayan foothills and southern China.

The Mentawi Islands, off western Sumatra, have some well-marked local forms such as the dwarf gibbon, a distinctive leaf monkey and the peculiar pig-tailed langur. The relationships of the other mammals are Sumatran.

Borneo, the largest of the islands, has more varied climatic and environmental conditions than other Greater Sunda Islands, or even than the Malay Peninsula. The mountains of the interior are a barrier dividing the lowlands of the northwestern part of the island from those of the southeastern. They provide conditions suitable for mountain-living species. Some of the large rivers also form barriers and restrict the ranges of certain species and races. A few high peaks, such as Kina Balu in the north and isolated Poi and Penrissen in the western corner of the island, have races, species, or even genera restricted to them.

Some of the mammals of Borneo appear to be related to present Chinese or Indo-Chinese forms: a red-cheeked ground squirrel, one of the slender-tailed tree shrews, and the proboscis monkey which is probably allied to the golden monkeys and the pied langurs. The ferret badger and banting may have reached Borneo from Indo-China but they also occur in Java. Several mammals known only from Borneo may have originated there, although derived from continental ancestral types. They are well-marked local species or genera such as several kinds of bats, the maroon and white-fronted leaf monkeys, the proboscis monkey, a form of banded palm civet, the Bornean mongoose, the bay cat, several squirrels, and the pygmy tree rat.

In addition to these mammals shared by Borneo only with Sumatra, several mammals unknown in Java occur on Borneo and Sumatra and also on the mainland. The pen-tailed tree shrew, the large gymnure or "moonrat," the water shrew, several kinds of bats, the pig-tailed macaque, banded leaf monkey, Malay bear, a weasel, the hairy-nosed otter, the masked and banded palm civets, otter civet, short-tailed mongoose, clouded leopard, marbled cat, several sorts of flying squirrels, the long-nosed ground squirrel, and the two-horned rhinoceros are such mammals.

Palawan and the nearby Caliamanes are related to Borneo faunally much as Bali is to Java. Their fauna is much poorer; it includes none of the species found only in Borneo. The common tree shrew, scaly anteater, Malay badger, binturong, small-clawed otter, mouse-deer, porcupine, and the Palawan flying squirrel are mammals typical of the Malay Subregion.

Java with Bali and Madura, which have less varied faunas, is the home of fewer mammals than Sumatra and Borneo. Most of the mammals are local races of species common to the Greater Sunda Islands, but a few, like the Javan wild pig, are restricted to the island. The banting and ferret badger, absent from Sumatra and the lower Malay Peninsula, are common to Java and Borneo.

Java is the only island in the group in which mammalian fossils have been found. Even those are relatively recent fossils of the Ice Age or Pleistocene. The most interesting discoveries in those deposits have been the remains of fossil man (*Pithecanthropus*), a man with many ape-like features, famed as the "missing link" between man and the ape. Actually this creature was much more human than is commonly supposed. Other relatively enormous forms closely related to *Pithecanthropus*, found in the Javan deposits, had teeth and jaws much larger than the gorillas.

There, too, were found remains of hyenas and bones of an extinct species of hippopotamus; hyenas are no longer found in the Malay Subregion and the hippo today occurs only in Africa. A distinct species of wild ox, related to the banting, a saber-toothed tiger, a mastodon, and primitive kinds of elephants called stegodonts, as well as several animals long thought to be giraffes but actually related to cattle, formerly lived in Java. The Eld deer or thamin, now found no nearer than Burma and Indo-China, lived in Java until a few thousand years ago.

The Australo-Oriental Subregion or Wallacea is here considered to include Celebes, the Lesser Sunda Islands from Lombok to Timor, and the Moluccas. This is the zone of overlap of Oriental and Australian mammals, in which the former greatly predominate.

Celebes, much the largest land mass in the Australo-Oriental Subregion, has a fauna largely Oriental in origin. This includes the anoa or pygmy buffalo, wild pigs, the babirusa, sambar deer, shrews, two distinctive macaques, the tarsier, several extraordinary rats, a long-nosed ground squirrel, civets and palm civets. The civets and sambar may have reached Celebes by human agency, and one of the shrews, the house musk shrew, was perhaps transported in canoes like house mice and rats. Deer and pigs are good swimmers; they may sometimes have advanced naturally through the chain of the Lesser Sunda Islands. The

anoa may have reached Celebes by the same route or from the Philippines. The presence on Mindoro of a dwarf buffalo, similar to the anoa, is not conclusive on this point, even if that similarity is considered evidence of close relationship rather than accidental convergence. The depths of the straits separating Celebes from Borneo, the Lesser Sundas, and Philippines are such that, considering also the faunal evidence, Celebes cannot have been connected with any of these during the later Tertiary. These straits were probably narrower than at present during part of the Ice Age; lowering of the sea level six hundred feet would reduce the width of the strait between south Celebes and Borneo to twenty-five miles. Smaller mammals were probably carried to Celebes from Borneo and other islands on drifting masses of trees and vegetation, such as are frequently torn loose by swollen rivers. The chances of survival under such conditions are especially poor for larger mammals, but shrews, rats, squirrels, several of which are closely related to Bornean species, palm civets, and monkeys may have arrived in Celebes in this way. The various degrees of differentiation shown by the rats and squirrels, some of which are generically distinct, some specifically, and some only racially, suggest that arrivals took place through a great length of time.

The only Australian element in Celebes consists of two species of cuscus (*Phalanger*), distinct from the several species of that genus present in New Guinea. The spinal-winged fruit bat (*Dobsonia*), although sometimes found as far west as Bali, is characteristic of the Papuan Subregion, as is the tube-nosed fruit bat (*Nyctimene*) and one of the long-tongued bats (*Syconycteris*). Two genera of fruit bats are known only from Celebes and its small associated islands. The lesser mosaic-tailed rat (*Melomys*) is a member of a large genus of rats with headquarters in New Guinea. This genus is represented also on the Talaut Islands between Celebes and the Philippines.

Saleyer, Sanghir, and Talaut Islands have many of the mammals found in Celebes. On the Sanghir group and Talaut are

phalangers, on the Sanghirs alone a tarsier. The spotted cuscus of New Guinea is represented on Saleyer. The presence of the tarsier on the Sanghir group may indicate that it came to Celebes from the Philippines by way of the Sanghirs; but it might have come from Borneo more easily.

The Molucca Islands are a scattered group, not uniform faunally. A flying phalanger (*Petaurus*) is found on Obi and Batjan; on these and on Halmahera (Gilolo) cuscuses and a bandicoot occur. The babirusa of Celebes occurs also in Buru. Other pigs, and sambar deer which reach east as far as Buru and the Gilolo group are found in Ceram. Pigs and deer are especially likely to be carried about by natives and to go wild. This fact explains their presence in New Guinea.

The Lesser Sundas, with the exception of the gray cuscus on Timor and Wetar, have no Australian land mammals. The Australian long-eared bat (*Nyctophilus*), reported from Timor, has not been certainly found there but the tube-nosed fruit bat (*Nyctimene*) reaches this island. Spinal-winged bats, widespread in the Australo-Oriental Subregion, are found throughout the Lesser Sunda chain. Bats are more limited by water barriers than may be thought but nevertheless may be carried about by storms. Consequently the distribution of these mammals is frequently erratic.

Relatively few Oriental mammals extend as far east as Timor. They include the long-tailed macaque monkey (not recorded from the other islands, however), sambar deer, pigs, shrews, the palm civet, and the slit-faced bat (*Nycteris*). This bat, as yet unrecorded from the other Lesser Sundas, may be found later on some of the larger ones. Porcupines reach east as far as Sumbawa and possibly Flores, while a single unsatisfactory record in 1867 of palm civet is known from the Aru Islands, off western New Guinea.

The Australian Faunal Region, including the Australian continent, Tasmania, New Guinea, the Bismarck and Solomon groups, has a mammal fauna characterized by many varieties

of marsupials, a few egg-laying mammals, and a number of peculiar bats and rats, especially the water rats and giant rats. Native mammals of other orders—insectivores, carnivores, ungulates, and primates (except man himself)—are absent, except in the cases of the wild descendants of animals brought by man. The Australian and Papuan Subregions based upon geography are not wholly satisfactory. The savannas of the extreme south of New Guinea are faunistically Australian; the rain forests of North Queensland are inhabited in part by species belonging to genera characteristic of New Guinea.

The Australian Subregion is populated mainly by primitive and ancient mammalian types, including a wide variety of kangaroos and wallabies, possums and flying phalangers, the koala, the wombat, bandicoots, the marsupial mole, the marsupial anteater, the Tasmanian devil, marsupial or "tiger" cats, marsupial mice, and finally the egg-laying monotremes which include the duckbill and spiny anteater. This fauna has probably been in Australia for millions of years, but there is little doubt that the first marsupials reached Australia from the northwest. At that time the present chain of East Indian islands may have connected with Asia. The pioneer marsupials which were probably small arboreal mammals, some perhaps a little like the American opossums and others like the modern Australian phalangers, can have reached the Australian Region on natural rafts almost as easily as across such a land bridge. From those pioneer forms the various families of Australian marsupials have branched out adaptively to take the places filled in other parts of the world by true carnivores, insectivores, squirrels, and hoofed mammals. During Pleistocene time—the ice ages—the Australian marsupials were even more varied than they are today; they included kangaroos as large as donkeys, a ground-living phalanger as large as a lion and with great shearing teeth, giant wombats bigger than tapirs, and a massive clumsy beast that must have compared in size with the hippopotamus.

The many peculiar rats of Australia came long after the

marsupials, as did some of the bats. The dingo was brought there by the early men who came near the end of the Pleistocene period. The dingo, very much like the earliest known domestic dogs, has no other near relatives in southeastern Asia.

The Papuan Subregion lacks a number of the distinctively Australian mammals. Of the archaic Australian fauna only wallabies, tree kangaroos, phalangers or possums, flying phalangers, bandicoots, marsupial cats, marsupial mice, and the spiny anteater are found there—a much less varied assemblage than on the continent. Of these the cuscus phalangers alone extend much beyond New Guinea. Of the bats, many are species characteristic of this subregion, but more frequently they are local forms of widely ranging bats, found in tropical Australia as well as in the islands east and west. The rats are, with a number of exceptions, closely related to Malaysian types, but even the most peculiar are rat-like and belong in the same family. The mammals which extend westward have been discussed under the Australo-Oriental Subregion. Cuscus phalangers reach the Solomon Islands, as do the giant and mosaic-tailed rats. Tube-nosed fruit bats (*Nyctimene*) and spinal-winged bats (*Dobsonia*) are other Papuan forms that reach these islands. Several genera of bats and rats, found only on the Solomons, are either relicts of ancient types or local developments.

Bandicoots and a spotted cuscus are found on the Admiralties; these with wallabies are the chief land mammals of the Bismarck group. Water rats extend northeast to New Britain; they are also found on the Aru and Kei Islands to the west. The other mammals of these last islands are much like those of southern New Guinea, but less varied.

New Guinea, the only large land mass of the Papuan Subregion, contains many more native species of mammals than the outlying islands. The bandicoots include four genera, two of them restricted to New Guinea and one chiefly Australian but found in southern and southeastern Papua. Marsupial mice are represented by several primitive forms, marsupial cats by a

single species. Phalangers or possums are both common and varied, while the characteristic tree kangaroos are found elsewhere only on Great Kei Island and Cape York, Australia. The New Guinea gazelle-faced wallabies (*Dorcopsis*) are a distinctive group; the island has also several distinct species of wallabies related closely to those of the continent. The feather-tailed phalanger, the striped phalangers (also on Aru) and several species of ring-tailed phalangers are typical of the Papuan fauna.

Close ties between southeastern New Guinea and northern Australia are shown by the presence on the island of the sand wallaby (*Wallabia agilis*), one of the short-nosed bandicoots (*Isoodon*), and dormouse phalangers. The common flying or gliding possums (*Petaurus*) belong to distinct species in the two subregions. Spinal-winged and tube-nosed bats, tree kangaroos, cuscuses, and mosaic-tailed rats represent New Guinea types that have reached the continent.

The Pacific islands north and east of the Australian Region, as restricted here, are extremely poor in mammals. Pigs, house rats, and mice have been carried to virtually all these islands from the East Indies by various human migrants, in many cases hundreds or thousands of years ago. Black rats, roof rats, and Norway rats have been taken to the more important islands by the vessels of white traders and explorers. These more aggressive forms often have driven from the villages the Polynesian rat, taken there much earlier by native travelers, and on some islands may have caused its extinction. Bats have been carried by storm, or have wandered, to many of the islands.

The Micronesian Islands have one or two species of flying foxes and a sheath-tailed insectivorous bat (*Emballonura*) in addition to rats and mice. In the Carolines there is also a long-tailed fruit bat (*Notopteris*), a primitive type known elsewhere only from the New Hebrides, New Caledonia, and Fiji. No bats are recorded from the Gilbert group, and only the sheath-tailed

bat is reported from the Marshall Islands. Absence of records may indicate either incomplete collecting or actual absence; such small islands offer few of the necessities of life, even for bats.

The Melanesian Islands (leaving out the Solomons and the Bismarck Archipelago, which have been discussed with New Guinea) harbor flying foxes, long-tailed fruit bats, and sheath-tailed bats. New Caledonia, the largest of these islands, has in addition one of the bent-winged bats and an insectivorous bat (*Chalinolobus*) related to Australian forms. The New Hebrides and Santa Cruz Islands have *Chalinolobus* and a leaf-nosed bat (*Hipposideros*).

New Zealand has a very interesting invertebrate and bird fauna, but its land mammals are restricted to two kinds of bats and introduced species of deer, elk, and various others. One of the two bats (*Mystacops*), placed in a family by itself, is perhaps a relict of the primitive group which gave rise to the free-tailed bats of the tropics and warmer zones of both hemispheres. The other is a common bat (*Chalinolobus*) related to those found in Australia and New Caledonia.

The Polynesian Islands, roughly definable as those east of the International Date Line, are inhabited for the most part only by introduced rats and mice. Samoa and the Tonga Islands, however, mark the eastward limits of the Australo-Oriental bats; and Hawaii is the home of a species of hoary bat (*Lasiurus*) derived from an American stock. Samoa, perhaps because its fauna has been better studied, is known to have two species of flying fox bats, a common bat (*Myotis*) of a genus almost world-wide in distribution, and a sheath-tailed bat (*Emballonura*). From the Tongas, several hundred miles farther east, only the flying fox is known.

The Juan Fernandez Islands were originally without native land mammals. Their aquatic mammals include sea lions, fur seals, and some true seals. Rats and mice have been introduced by whalers and sealers, and goats were turned loose and in-

creased enormously. For a while dogs lived on the island but they have disappeared.

The Galapagos Islands, situated more than five hundred miles from the coast of Ecuador and separated from it by water more than a thousand fathoms deep, have probably never been in contact with the continent. Yet they are inhabited by several rats of a tropical American group related to our rice rats (*Oryzomys*). Although these rats have been isolated from one another on the various islands for a long enough period of time to allow a number of races and species to develop, they have not diverged enough from the mainland forms to be considered a separate genus. A bat (*Lasiurus*) closely related to the red bats of the Americas and the Hawaiian bat, is also found on the islands. Some species of this genus normally make long migratory flights; of all the American bats they are the most likely ones to be carried far out of their usual range. The ships of whalers and sealers used to put in at the Galapagos and for many years a penal colony was located there. As a result house rats and mice have invaded the islands. Liberated pigs, cattle, and goats have gone wild, doing much injury to the native vegetation.

The Pacific islands from the Solomons and the Northern Micronesian group to Hawaii, the Galapagos, and Juan Fernandez are all truly oceanic. On a basis of their mammals they cannot be related closely to the faunal regions used here. The Galapagos and Juan Fernandez Islands may be considered Neotropical or South American.

4

Conservation of Mammals

The animals that live on these Pacific islands and others should be allowed to persist almost indefinitely in order to provide interest, information, sport, and even a means of livelihood for the present and future generations, but they may be destroyed in a few years by thoughtless and wasteful hunting.

NEED FOR PRESERVATION

Island mammals are in a difficult situation for survival, even when no human beings are present. The number of individuals of any species is limited by the area of the island; a limited number can find food or shelter necessary to life. Related or similar species may be present to compete for minimal requirements, a condition which still further limits the number of individuals of the first mammal. If natives are present, the land they cultivate reduces the area available for the animals, and the natives eke out their food supply by hunting and trapping. A few species are actually benefited by the presence of man; several rodents make their homes with him and feed parasitically on the food he grows and stores. The natives are usually neither numerous enough nor well enough supplied with modern guns to effect great changes in the animal population, but they may exterminate large, slow-breeding mammals if the wild island population of a species is small enough to be at a critical point. For example, although the only banting now found in Bali are domesticated, wild banting may very well have occurred there formerly. This may also explain why the elephant, which was

in Java during the Pleistocene, is not found there today. Hunters with modern rifles and shotguns can all too easily exterminate most of the game animals in a short time on the smaller islands and can seriously reduce those on the larger islands.

Many mammals found on islands are different from those that occur elsewhere; sometimes this difference is only slight, but in other cases it is obvious and important. To a biologist or one interested in nature it is one of the greatest crimes against science to destroy any form of wild life completely. A species is a unique thing—the product of natural forces and circumstances through the ages—and if once exterminated it cannot be replaced. Some of the island mammals are remnants of ancient groups that have survived until the present, thanks to their isolation and protection from competition with more modern mammals by the barriers of sea straits. These living fossils are often less adaptable to changing conditions than more up-to-date mammals; often clearing the jungle for plantations is enough to destroy them. The Luchu and Sumatran rabbits, the long-tailed fruit bats of the Melanesian Islands, the New Zealand bat, the babirusa, anoa, macaque, and black ape of Celebes, a small deer on the Bawean Islands near Java, the tapir of Sumatra and the Malay Peninsula, the two Malaysian rhinoceroses, many of the marsupials, and a number of inconspicuous mammals of other groups are in need of sanctuary. Every effort should be made to protect these rare and scientifically invaluable animals.

COLLECTING AND STUDY OF SPECIMENS

Those persons who have free time on their hands and find themselves in areas poorly known zoologically, and those who find mammals they cannot identify from the descriptions in this handbook or mammals out of their known range, can do a great deal for natural science by preserving specimens. Skins with skulls, and complete specimens properly preserved and accom-

panied by notes on the exact locality or origin would add much to our knowledge and would be of the greatest interest to scientists and institutions. A field catalogue with this information and numbers corresponding to the data attached to the specimens would serve to keep this important material for future reference. Collecting can be both interesting and worthwhile, but of course should not be done if a species is so near extinction that this will increase the jeopardy.

In the tropics the heat and humidity cause the hair to "slip" or come off with the epidermis of the skin unless the mammal is skinned shortly after death. Larger mammals should be slit from the breast to the end of the tail; other cuts are made from the sole of the feet or just above the hoofs to meet the median cut. Horned mammals require an additional cut from the neck to between the horns and then a cut from this line, on each side, to the horns and around them. For best results the ear cartilage must be skinned out and the toe-bones as far as the claw or hoof, and the flesh that is closely attached to the skin should be cut away. Salt should then be thoroughly rubbed into the skin on the flesh side and the skin rolled up overnight. It should then be spread out in the shade to dry. In very wet weather and climates the salt will keep taking up water from the air and the skin will not dry; in this case, after a second thorough rubbing with salt and leaving over a second night, wash the skin in fresh water and dry under shelter. A fire may help, but scorching the skin must be avoided.

The skull should be carefully disjointed from the neck, the flesh roughly trimmed off and the brain removed through the hole at the rear end (*foramen magnum*). The skull should be dried as thoroughly as possible. Smoking, salting, or covering it with pepper may help keep maggots out; they injure the bone, especially of small skulls. Skins and skulls of the same individual should have identical numbers.

Smaller mammals may be cased, that is, cut from heel to heel across the underside and the skin turned inside out like a glove,

leaving the feet attached, as most commercial furs are fixed in the United States. Or a cut may be made from the breast to between the hind legs, and the legs cut off the body at the knee, the skin worked off the rump and then off the rest of the body. The tail can usually be pulled out by holding the tail loosely in a V-shaped stick and pulling on the vertebrae. A little crumpled paper, tow or straw put inside the hairy pocket formed by the inside-out skin, to keep the fur surfaces apart and a straw splinter of bamboo pushed to the end of the tail will permit the skin to dry safely in all except the worst weather. Arsenical soap or a mixture of arsenic powder and alum, half and half, will preserve the skin.

Bats and some other small mammals are easily preserved in a formalin solution: one part commercial formalin to ten parts water, or one part to forty parts saturated salt solution. The abdomen should be opened to let the solution penetrate the intestines, which may otherwise spoil.

Skulls can be saved when the skin is spoiled or when a dead carcass is found in the wilds. The teeth and measurements of such skulls are very interesting scientifically if the locality from which they come is known. Various museums will identify such skulls for any curious finder.

A booklet giving the details of collecting and preparing specimens may be obtained from the American Museum of Natural History, New York 24, New York.

Glossary

amphibious. Able to live on land and in the water.

anthropoid. The group of monkeys most resembling man; man-like.

antilopine. Like an antelope.

aquatic. Living in the water.

arboreal. Living in trees.

archaic. Of an earlier or primitive age; antiquated.

basined teeth. With basin-shaped hollows on crowns of teeth.

bipedal. Walking or running on the hind legs and feet.

canine teeth. Eye teeth or dog teeth, usually longer than other teeth and sharp-pointed.

circumpolar. Surrounding the pole, that is, found in northern parts of both hemispheres.

cusps. Points on the crowns of teeth.

diastema. A gap between teeth.

distal. Farthest away from the body. The hand is attached to the distal part of the forearm.

diurnal. Active during daylight hours.

embryonic. Pertaining to an embyro or unborn young.

enamel. A hard substance which forms a thin layer capping or partly covering the teeth of most mammals.

environment. The sum total of the surroundings affecting the life of an organism.

extinct, extinction. No longer living. Applied to species, etc., not to individuals.

feral. Having escaped from domestication and become wild.

forearm. The part of the arm between the elbow and wrist.

genus (plural, **genera**). A classification ranking between family and species.

gregarious. Habitually living with numbers of its kind.

habitat. The natural abode of an animal or plant, or the particular location where it normally lives.

hibernate. To pass the winter in a more or less torpid state.

incisor teeth. The front teeth.

indigenous. Native to a country.

interfemoral membrane. Membrane situated between the hind legs. Present in bats.

lemur. Primitive relatives of monkeys found in Madagascar, Africa, and the Orient.

locomotion. Act or power of moving from place to place.

longitudinal. Extending lengthwise.

marsupial. Pouched. In mammals, members of an order the females of which usually have pouches, or are pouchless descendants of pouched ancestors.

melanistic. Having a high degree of blackish pigmentation which produces a very dark or black color.

metacarpal. Long bones of the hand or forefoot between wrist and fingers.

metatarsal. Long bones of hind foot between ankle and toes.

molar teeth. One, two, or three teeth in the rear of the jaw used for chewing and not preceded by deciduous teeth.

mosaic-tailed. A type of scale arrangement in certain rats in which the scales, instead of overlapping, touch edge to edge like a mosaic.

mutant. An individual differing from the usual members of the same species; for instance, a white animal of a species that is usually gray or brown.

obsolete. No longer used; no longer present.

opposable. Of the thumb, first toe, or other fingers and toes. The ability to act like a man's thumb in grasping.

palearctic. Pertaining to a region of the world including Europe, Asia north of the Himalayas, northern Arabia, and Africa north of the Sahara.

palmate (of antlers). Broad, resembling the spread-out hand of a man, the points extending like fingers.

pedicel. A supporting part, as a stem or stalk.

pelage. The coat of hair or fur covering a mammal.

physiography. Description of the form and physical features of the surface of the earth.

physiology. The life processes of an animal.

plantigrade. Walking on the sole with the heel touching the ground; in opposition to digitigrade, walking on the toes like dogs and cats.

Pleistocene. The most recent past geological period, during which large ice-caps were developed in Europe and North America; between the Pliocene and present, roughly from ten thousand to a million years ago.

prehensile. Adapted for grasping. Applied to hands, feet, and tails of mammals.

premolar teeth. Chewing teeth between canines and molars, usually less broad than the latter; preceded by deciduous teeth.

primitive. Pertaining to the beginning or origin, like mammals whose structure approximates that of ancestral mammals.

proboscis. A long, flexible nose or trunk.

protrusible. Capable of being protruded or thrust out.

relicts. Survivors. In zoology, often used for species which have persisted for long periods after their allies have become extinct.

sacculated. Having a series of sac-like expansions.

specialized. Designed, fitted, or adapted for use in one special manner.

spout (of whales). The column of vapor; the exhaled breath sent out through the nostril (blowhole) of a whale when it comes up for breath.

tactile. Touching. In some mammals, special tactile surfaces of toes, fingers, and the tips of tails; also tactile hairs, as cats' whiskers.

talon. In bats, a subsidiary claw-like process at the base of the real claw.

termites. White ants; pale-colored, soft-bodied insects of the family Termitidæ. They are not true ants.

terrestrial animals. Those that live on the ground in contrast to those that live in the water or in trees.

Tertiary. The last great period of geologic time following the Mesozoic or Age of Dinosaurs. Most modern orders of mammals developed during the Tertiary period.

trefoil. Shaped like a three-leafed clover.

truncate. Cut off; chopped off.

W-pattern. In describing teeth, crowns with cusp pattern, when seen from above, arranged like the letter W.

Alphabetical Index-Checklist of the Islands

The islands and island groups, each followed by the mammals found there, are listed in alphabetical order. Page references indicate the places in the text where the various mammals are described. In the descriptions of the mammals, their distribution was frequently given in a general manner, many islands and island groups being included by implication without actual mention. The index-checklist is meant to be inclusive. For example, in this index under Java, giant squirrels (*Ratufa*), are listed; the text discussion says only "They are found from the mainland to Bali and Borneo." Java is, of course, included in the area thus bounded. Some of the islands thus included by implication lack the giant squirrel—for example, Nias Island, a small island off western Sumatra.

Inclusion of a species indicates that it has been reported or is very probable on an island, but its omission from certain islands may be due to our lack of knowledge or of collecting. If a reader should find a mammal on an island where it is not listed, it is very desirable that he send this record, with a photograph or specimen, to some museum for checking and confirmation.

Admiralty Islands, North of New Guinea

BATS. flying fox (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48.
MARSUPIALS. cuscus (*Phalanger*), 25; spiny bandicoot (*Echymipera*), 21.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Aleutian Islands, West from Alaska

CARNIVORES. Alaskan brown bear (*Ursus*), 79; Arctic fox (*Alopex*), 86; mink (*Mustela vison*), 82; pygmy weasel

(*Mustela rixosa*), 82; red fox (*Vulpes*), 86; sea otter (*Enhydra*), 84; wolf (*Canis*), 84; wolverine (*Gulo*), 82
EVEN–TOED UNGULATES. caribou (*Rangifer*), 146.
INSECTIVORES. red-toothed shrew (*Sorex*), 40.
RABBITS. Arctic hare (*Lepus poadromus*), 124.
RODENTS. Arctic ground squirrel (*Citellus*), 111; collared lemming (*Dicrostonyx*), 120; common rat (*Rattus*), 114; house mouse (*Mus*), 113; lemming mouse (*Synaptomys*), 120; meadow mouse (*Microtus*), 120; red lemming (*Lemmus*), 119.
SEALS, SEA LIONS. bearded seal (*Erignathus*), 104; harbor seal (*Phoca*), 104; northern fur seal (*Callorhinus*), 102; ribbon seal (*Histriophoca*), 104; Steller's sea lion (*Eumetopias*), 101; walrus (*Odobenus*), 106.

Alor Island (Ombay), near Timor, East Indies

BATS. flying foxes (*Pteropus, Acerodon*), 48; rousette or dog bat (*Rousettus*), 48; spinal-winged bat (*Dobsonia*), 48.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Amboina, see Ceram

Anamba Islands, South China Sea

BATS. bent-winged bat (*Miniopterus*), 59; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bat (*Cynopterus*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN–TOED UNGULATES. mouse deer (*Tragulus*), 149; pig (*Sus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrews (*Tupaia*), 43; white-toothed shrew (*Suncus*), 40.
MONKEYS, LEMURS. long-tailed macaque (*Macaca irus*), 67; slow loris (*Nycticebus*), 76.
RODENTS. common rats (*Rattus*), 114; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; Oriental squirrel (*Callosciurus*), 110; striped ground squirrel (*Lariscus*), 111.

Arafura Sea, North of Australia

DUGONG (*Dugong*), 136.
WHALES. blackfish or pilot whale (*Globiocephalus*), 132; common dolphin (*Delphinus delphis*), 134; false killer (*Pseudorca*), 132; finless black porpoise (*Neomeris*), 132; humpback (*Megaptera*), 128; killer (*Orcinus*), 131; red-bellied dolphin (*Delphinus roseiventris*), 134; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129.

Arends Island, Java Sea

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Aru Islands, Arafura Sea

BATS. common bat (*Myotis*), 55; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Syconycteris*), 49; sheath-tailed bats (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149.
MARSUPIALS. flying phalanger or possum (*Petaurus*), 27; spiny bandicoot (*Echymipera*), 21; striped possum (*Dactylopsila*), 24; wallaby (*Thylogale*), 32; marsupial mouse (*Sminthopsis*), 20.
RODENTS. common rat (*Rattus*), 114; giant rat (*Uromys*), 116; house mouse (*Mus*), 113; water rat (*Hydromys*), 118.

Australia

BATS. Australian long-eared bat (*Nyctophilus*), 60; bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Eptesicus, Scoteinus, Chalinolobus*), 55; false vampire (*Macroderma*), 53; flying foxes (*Pteropus*), 48; free-tailed or mastiff bat (*Tadarida*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros, Rhino-*

nycteris), 53; long-tongued fruit bats (*Macroglossus*—on Sunday Island and Murray Island only; *Syconycteris*), 49; sheath-tailed bats (*Taphozous, Saccolaimus*), 51; spinal-winged fruit bat (*Dobsonia*), 48; trumpet-eared bat (*Phoniscus*), 61; tube-nosed fruit bat (*Nyctimene*), 48.

CARNIVORES. dingo (*Canis*), 85.

EGG–LAYING MAMMALS. duckbill or platypus (*Ornithorhynchus*), 11; spiny anteater or echidna (*Tachyglossus*), 14.

MARSUPIALS. banded anteater (*Myrmecobius*), 20; bandicoots (*Isoodon, Perameles, Macrotis, Chœropus*), 21; cuscus (*Phalanger*), 25; flying possum (*Acrobates, Petaurus, Schoinobates*), 27; hare wallabies (*Lagostrophus, Lagorchestes*), 34; honey possum (*Tarsipes*), 30; kangaroos (*Macropus*), 31; koala (*Phascolarctos*), 29; marsupial mole (*Notoryctes*), 22; marsupial rats and mice (*Phascogale, Sminthopsis, Antechinomys*), 20; mouse possum (*Eudromicia*), 25; marsupial wolf, extinct (*Thylacinus*), 17; musk kangaroo (*Hypsiprymnodon*), 36; nail-tailed wallaby (*Onychogale*), 33; native cats (*Dasyurus*), 19; pademelons (*Thylogale, Setonix*), 32; possum (*Trichosurus*), 23; rat kangaroos (*Bettongia, Aepyprymnus, Potorous*), 36; ring-tailed possums (*Pseudocheirus, Petropseudes*), 26; rock wallabies (*Petrogale, Peradorcas*), 33; striped possum (*Dactylopsila*), 24; Tasmanian devil (*Sarcophilus*), 18; tree kangaroo (*Dendrolagus*), 34; wallabies (*Wallabia, Thylogale, Setonix*), 32; wallaroo (*Osphranter*), 32; wombats (*Vombatus, Lasiorhinus, Vombatula*), 30.

RODENTS. broad-toothed rat (*Mastacomys*), 117; common rat (*Rattus*), 114; false water rat (*Xeromys*), 118; giant naked-tailed rat (*Uromys*), 116; native mice (*Thetomys, Leggadina, Gyomys*), 117; pouched hopping mice (*Notomys, Ascopharynx*), 118; pseudo-rat (*Pseudomys*), 117; rabbit rat (*Mesembriomys*), 117; stick-nest rat (*Leporillus*), 118; thick-tailed rat (*Laomys*), 117; water rat (*Hydromys*), 118; white-tailed rat (*Zyzomys*), 117.

SEALS, SEA LIONS. fur seals (*Arctocephalus*), 102; seals (*Hydrurga, Leptonychotes, Lobodon*), 104; sea lions (*Neophoca*), 100.

Babi Island, see Simalur Island

Balabac Island, see Palawan Island

Bali

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Tylonycteris, Scotophilus*), 55; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; rousette or dog bat (*Rousettus*), 48; short-nosed fruit bat (*Cynopterus*), 48; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bat (*Kerivoula*), 61.
CARNIVORES. civet (*Viverricula*), 87; leopard cat (*Felis bengalensis*), 98; palm civet (*Paradoxurus*), 89; tiger (*Felis tigris*), 95.
EVEN-TOED UNGULATES. muntjac or barking deer (*Muntiacus*), 147; sambar deer (*Cervus*), 144.
INSECTIVORES. tree shrew (*Tupaia*), 43; white-toothed shrew (*Suncus*), 40.
MONKEYS. leaf monkey (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; porcupine (*Hystrix*), 121.
SCALY ANTEATER (*Manis*), 107.

Banda Sea

DUGONG (*Dugong*), 136.
WHALES. blackfish or pilot whale (*Globiocephalus*), 132; common dolphin (*Delphinus*), 134; false killer whale (*Pseudorca*), 132; finless black porpoise (*Neomeris*), 132; killer whale (*Orcinus*), 131; red-bellied dolphin (*Delphinus roseiventris*), 134; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129.

Banjak Islands, West Sumatra

EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149; pig (*Sus*), 149.

FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrew (*Tupaia*), 43.
MONKEYS. long-tailed macaque monkey (*Macaca irus*), 67.
RODENTS. common rat (*Rattus*), 114; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; Oriental squirrel (*Callosciurus*), 110.

Banka Island, East Sumatra

BATS. common bat (*Pipistrellus*), 56; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; naked free-tailed bat (*Cheiromeles*), 62; sheath-tailed bat (*Emballonura, Saccolaimus*), 51; short-nosed fruit bat (*Cynopterus*), 48.
CARNIVORES. binturong (*Arctictis*), 91; civet (*Viverra*), 86; hairy-nosed otter (*Lutra sumatrana*), 84; linsang (*Prionodon*), 88; palm civet (*Paradoxurus*), 89; small-toothed palm civet (*Arctogalidia*), 92; yellow-throated marten (*Martes*), 81.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149; muntjac or barking deer (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrews (*Tupaia, Ptilocercus*), 43; white-toothed shrew (*Crocidura*), 40.
MONKEYS, LEMURS. leaf monkey (*Presbytis*), 70; long-tailed macaque monkey (*Macaca irus*), 67; pig-tailed macaque (*M. nemestrina*), 67; slow loris (*Nycticebus*), 76; tarsier (*Tarsius*), 78.
RODENTS. common rat (*Rattus*), 114; flying squirrel (*Hylopetes*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110.
SCALY ANTEATER (*Manis*), 107.

Batjan (Batchian) Island, see Molucca Islands

Batu Islands, West Sumatra

BATS. flying fox (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; short-nosed fruit bat (*Cynopterus*), 48.

CARNIVORES. small-toothed palm civet (*Arctogalidia*), 92.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrews (*Tupaia, Ptilocercus*), 43.
MONKEYS, LEMURS. leaf monkey (*Presbytis*), 70; long-tailed macaque monkey (*Macaca irus*), 67; slow loris (*Nycticebus*), 76.
RODENTS. common rat (*Rattus*), 114; flying squirrel (*Petaurista*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; striped ground squirrel (*Lariscus*), 111.

Bawean Island, Java Sea

BATS. flying fox (*Pteropus*), 48.
EVEN-TOED UNGULATES. pigs (*Sus*), 149; sambar deer (*Cervus*), 144.
MONKEYS. long-tailed macaque monkey (*Macaca irus*), 67.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Bering Sea

WHALES. Baird whale (*Berardius*), 130; beaked whale (*Mesoplodon*), 131; blackfish or pilot whale (*Globiocephalus*), 132; bowhead or Greenland right whale (*Balæna*), 127; Dall's porpoise (*Phocœnoides*), 132; gray or Risso's dolphin (*Grampus*), 131; finback or rorqual (*Balænoptera*), 128; killer whale (*Orcinus*), 131; Pacific right whale (*Eubalæna*), 127; right whale dolphin (*Lissodelphis*), 133; striped or white-sided dolphin (*Lagenorhynchus*), 133.

Billiton Island, Java Sea

BATS. common bat (*Pipistrellus*), 56; flying fox (*Pteropus*), 48; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bat (*Cynopterus*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89; small-toothed palm civet (*Arctogalidia*), 92.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149; muntjac or barking deer (*Muntiacus*), 147; sambar deer (*Cervus*), 144.

INSECTIVORES. tree shrews (*Tupaia*), 43.
MONKEYS, LEMURS. leaf monkey (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; tarsier (*Tarsius*), 78.
RODENTS. common rat (*Rattus*), 114; flying squirrel (*Petinomys*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.
SCALY ANTEATER (*Manis*), 107.

Boeroe Island, see Buru.

Bonin Islands, northern Micronesia (Volcano Islands, Perry Group, Ogasawara Shoto)

BATS. common bat (*Pipistrellus*), 56; flying fox (*Pteropus*), 48.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Borneo

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Glischropus, Tylonycteris, Hesperoptenus, Scotophilus*), 55; false vampire (*Megaderma*), 53; flying foxes (*Pteropus*), 48; free-tailed bats (*Tadarida, Cheiromeles*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura, Saccolaimus, Taphozous*), 51; slit-faced bat (*Nycteris*), 52; short-nosed fruit bats (*Cynopterus, Dyacopterus, Megaerops, Balionycteris, Aethalops, Penthetor*), 48; trumpet-eared bat (*Kerivoula*), 61; tube-nosed bat (*Murina*), 59.
CARNIVORES. banded palm civet (*Hemigalus*), 93; bare-footed weasel (*Mustela*), 82; bay cat (*Felis badia*), 98; binturong (*Arctictis*), 91; civet (*Viverra*), 86; clouded leopard (*Felis nebulosa*), 96; ferret badger (*Helictis*), 83; flat-headed cat (*Felis planiceps*), 98; hairy-nosed otter (*Lutra sumatrana*), 84; leopard cat (*Felis bengalensis*), 98; linsang (*Prionodon*), 88; Malay badger (*Mydaus*), 83; Malay bear (*Helarctos*), 80; marbled cat (*Felis*

marmorata), 96; masked palm civet (*Paguma*), 91; mongoose (*Herpestes*), 93; otter civet (*Cynogale*), 93; palm civet (*Paradoxurus*), 89; small-clawed otter (*Lutra cinerea*), 84; small-toothed palm civet (*Arctogalidia*), 92; yellow-throated marten (*Martes*), 81.

ELEPHANT (*Elephas*), 136.

EVEN–TOED UNGULATES. banting (*Bibos*), 139; buffalo (Bubalus), 140; mouse deer (*Tragulus*), 149; muntjac or barking deer (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144.

FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.

INSECTIVORES. gymnures (*Echinosorex, Hylomys*), 38; tree shrews (*Tupaia, Dendrogale, Ptilocercus*), 43; water shrew (*Chimarrogale*), 41; white-toothed shrews (*Crocidura, Suncus*), 40.

MONKEYS, APES, LEMURS. gray gibbon (*Hylobates moloch*), 66; leaf monkeys (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; orang-utan (*Pongo*), 63; pig-tailed macaque (*M. nemestrina*), 67; proboscis monkey (*Nasalis*), 75; slow loris (*Nycticebus*), 76; tarsier (*Tarsius*), 78.

ODD–TOED UNGULATES. Sumatran two-horned rhinoceros (*Dicerorhinus*), 153.

RODENTS. common rats (*Rattus*), 114; complex-toothed mouse (*Chiropodomys*), 116; flying squirrels (*Petaurista, Hylopetes, Petinomys, Iomys, Pteromyscus, Petaurillus*), 109; giant squirrel (*Ratufa*), 110; long-nosed squirrel (*Rhinosciurus*), 112; house mouse (*Mus*), 113; long-tailed porcupine (*Trichys*), 122; Oriental squirrels (*Callosciurus*), 110; pygmy ground squirrel (*Glyphotes*), 111; pygmy squirrel (*Nannosciurus*), 110; pygmy tree mouse (*Hæromys*), 114; porcupines (*Hystrix*), 121; red-cheeked ground squirrel (*Dremomys*), 111; striped ground squirrel (*Lariscus*), 111; tufted-eared ground squirrel (*Rheithrosciurus*), 112.

SCALY ANTEATER (*Manis*), 107.

Buru Island, Moluccas

BATS. bent-winged bat (*Miniopterus*), 59; common bat (*Myotis*), 55; flying fox (*Pteropus*), 48; horseshoe bat (*Rhino-*

lophus), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bat (*Macroglossus*), 49; rousette or dog bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; Tomb bats (*Taphozous*), 51; tube-nosed fruit bat (*Nyctimene*), 48; tube-nosed insectivorous bat (*Murina*), 59.
CARNIVORES. civet (*Viverra*), 86.
EVEN-TOED UNGULATES. babirusa (*Babirussa*), 150; sambar deer (*Cervus*), 144.
MARSUPIALS. cuscus (*Phalanger*), 25.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Cagayan Sulu, Sulu Sea

BATS. flying fox (*Pteropus*), 48; free-tailed bat (*Tadarida*), 62; long-tongued bat (*Macroglossus*), 49.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Calamianes Islands, see Palawan Island

Caroline Islands, Micronesia

BATS. flying fox (*Pteropus*), 48; long-tailed bat (*Notopteris*), 50; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Celebes

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Tylonycteris, Scotophilus, Pipistrellus*), 55; false vampire (*Megaderma*), 53; flying foxes (*Pteropus, Acerodon, Boneia, Harpionycteris, Styloctenium*), 48; free-tailed bats (*Tadarida, Cheiromeles*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; rousette or dog bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bats (*Cynopterus, Thoopterus*), 48; slit-faced bat (*Nycteris*), 52; spinal-

winged bat (*Dobsonia*), 48; trumpet-eared bats (*Kerivoula, Phoniscus*), 61; tube-nosed fruit bat (*Nyctimene*), 48; tube-nosed insectivorous bat (*Murina*), 59.
CARNIVORES. civets (*Viverra, Viverricula*), 86; palm civets (*Paradoxurus, Macrogalidia*), 89.
EVEN–TOED UNGULATES. babirusa (*Babirussa*), 150; pig (*Sus*), 149; pygmy buffalo (*Anoa*), 141; sambar deer (*Cervus*), 144.
INSECTIVORES. white-toothed shrews (*Crocidura, Suncus*), 40.
MARSUPIALS. cuscus (*Phalanger*), 25.
MONKEYS, LEMURS. black ape (*Cynopithecus*), 69; Celebes macaque (*Macaca maura*), 68; tarsier (*Tarsius*), 78.
RODENTS. common rats (*Rattus*), 114; complex-toothed rats (*Lenomys*), 116; house mouse (*Mus*), 113; long-nosed ground squirrel (*Hyosciurus*), 112; Oriental squirrels (*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110; pygmy tree rat (*Hæromys*), 114; porcupine (*Hystrix*), 121; shrew rats (*Echiothrix, Melasmothrix*), 115.

Celebes Sea

DUGONG (*Dugong*), 136.
WHALES. None recorded, see Java Sea and Strait of Malacca for probable ones.

Ceram and Amboina Islands, Moluccas

BATS. bent-winged bat (*Miniopterus*), 59; common bat (*Myotis*), 55; flying fox (*Pteropus*), 48; free-tailed bat (*Tadarida*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Syconycteris*), 49; rousette or dog bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48; tube-nosed insectivorous bat (*Murina*), 59.
CARNIVORES. civet (*Viverra*), 86; palm civet (*Paradoxurus*), 89.
EVEN–TOED UNGULATES. pig (*Sus*), 149; sambar deer (*Cervus*), 144.

MARSUPIALS. bandicoot (*Rhynchomeles*), 21; cuscus (*Phalanger*), 26.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; mosaic-tailed rat (*Melomys*), 116.

Chatham Islands, South Pacific

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.
SEALS, SEA LIONS. crab-eating seal (*Lobodon*), 105; New Zealand fur seal (*Arctocephalus*), 103; Weddell seal (*Leptonychotes*), 105.

Christmas Island, Indian Ocean

BATS. common bat (*Pipistrellus*), 56; flying fox (*Pteropus*), 48.
INSECTIVORES. white-toothed shrew (*Crocidura*), 40.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Christmas Island, Polynesia, and group (Palmyra, Washington, Fanning, Walker, Jarvis)

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Cook Islands (Hervey), Polynesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Coral Sea, southwest Pacific

DUGONG (*Dugong*), 136.
WHALES. beaked whale (*Mesoplodon*), 131; blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; Cuvier's or goosebeak whale (*Ziphius*), 131; false killer whale (*Pseudorca*), 132; gray or Risso's dolphin (*Grampus*), 131; killer whale (*Orcinus*), 131; pygmy right whale

(*Neobalæna*), 128; pygmy sperm whale (*Kogia*), 130; red-bellied dolphin (*Delphinus*), 134; sperm whale (*Physeter*), 129.

D'Entrecasteaux, Louisiade and Trobriand Islands, Coral Sea

BATS. flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bat (*Syconycteris*), 49; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bat (*Phoniscus*), 61; tube-nosed fruit bat (*Nyctimene*), 48.
MARSUPIALS. cuscus (*Phalanger*), 25; flying possum (*Petaurus*), 27; spiny bandicoot (*Echymipera*), 21.
RODENTS. common rat (*Rattus*), 114; complex-toothed rat (*Pogonomys*), 116; giant rat (*Uromys*), 116; house mouse (*Mus*), 113; water rat (*Hydromys*), 118.

East China Sea

DUGONG (*Dugong*), 136.
WHALES. blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; false killer whale (*Pseudorca*), 132; finback or sei whale (*Balænoptera*), 128; finless black porpoise (*Neomeris*), 132; gray or Risso's dolphin (*Grampus*), 131; humpback whale (*Megaptera*), 128; killer whale (*Orcinus*), 131; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129; white dolphin (*Sotalia*), 135.

Ellice Islands, Micronesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Engano Island, South Sumatra

BATS. common bat (*Pipistrellus*), 56; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura, Saccolaimus*), 51; trumpet-eared bat (*Kerivoula*), 61.

CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Fiji Islands, Melanesia

BATS. flying fox (*Pteropus*), 48; long-tailed bat (*Notopteris*), 50; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Flores Island, Lesser Sundas

BATS. common bat (*Scotophilus*), 58; flying foxes (*Pteropus*), 48; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Taphozous*), 51; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bat (*Kerivoula*), 61; tube-nosed bat (*Murina*), 59.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149; sambar deer (*Cervus*), 144.
PRIMATES. long-tailed or crab-eating macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; complex-toothed rats (*Mallomys*), 116; house mouse (*Mus*), 113; porcupine (*Hystrix*), 121.

Flores Sea

DUGONG (*Dugong*), 136.
WHALES. See Java Sea.

Formosa

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Scotophilus*), 55; flying fox (*Pteropus*), 48; free-tailed bat (*Tadarida*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53.
CARNIVORES. Asiatic black bear (*Selenarctos*), 80; civet (*Viverricula*), 87; clouded leopard (*Felis nebulosa*), 96; crab-eating mongoose (*Herpestes*), 94; Eurasian otter (*Lutra lutra*), 84; ferret badger (*Helictis*), 83; fishing

cat (*Felis viverrina*), 98; leopard cat (*Felis bengalensis*), 98; masked palm civet (*Paguma*), 91; Oriental weasel (*Mustela siberica*), 82; yellow-throated marten (*Martes*), 81.
EVEN-TOED UNGULATES. Muntjac (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144; serow (*Capricornis*), 142; sika deer (*Cervus*), 146.
INSECTIVORES. hedgehog (*Erinaceus*), 38; long-tailed shrews (*Soriculus, Chodsigoa*), 40; mole (*Mogera*), 42; white-toothed shrew (*Suncus*), 40.
MONKEYS. Formosa macaque (*Macaca cyclopsis*), 68.
RABBITS. Formosa hare (*Caprolagus*), 125.
RODENTS. bandicoot rat (*Bandicota*), 115; common rat (*Rattus*), 114; flying squirrels (*Petaurista, Belomys*), 109; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; red-cheeked ground squirrel (*Dremomys*), 111; wood mouse (*Apodemus*), 114.
SCALY ANTEATER (*Manis*), 107.

Friendly Islands, see Tonga

Galapagos Islands, East Pacific Ocean

BATS. red bat (*Lasiurus*), 59.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; South American rats (*Oryzomys*), 120.
SEALS, SEA LIONS. southern sea lion (*Otaria*), 101; southern fur seal (*Arctocephalus*), 103.

Gilbert Islands, Micronesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Halmahera, see Molucca Islands

Hawaiian Islands

BATS. hoary bat (*Lasiurus*), 59.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.
SEALS. Hawaiian monk seal (*Monachus*), 105.

Hervey Islands, see Cook Islands

Indian Ocean, eastern part

DUGONG (*Dugong*), 136.

WHALES. blackfish or pilot whale (*Globiocephalus*), 132; blue whale (*Sibbaldus*), 128; bottle-nosed porpoise (*Tursiops*), 134; common dolphin (*Delphinus*), 134; Cuvier's or goose-beaked whale (*Ziphius*), 131; finback whale (*Balænoptera*), 128; humpback (*Megaptera*), 128; Irrawaddi dolphin (*Orcella*), 132; killer whale (*Orcinus*), 131; lead-colored dolphin (*Sotalia plumbea*), 135; long-beaked dolphin (*Steno*), 135; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129.

Japanese Islands

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Plecotus, Barbastella, Nyctalus, Pipistrellus, Vespertilio*), 55; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; tube-nosed bat (*Murina*), 59.

CARNIVORES. Asiatic black bear (*Selenarctos*), 80; badger (*Meles*), 82; ermine or stoat (*Mustela erminea*), 81; Eurasian bear (*Ursus*), 79; Eurasian otter (*Lutra lutra*), 84; Japanese marten (*Martes*), 81; Oriental weasel (*Mustela siberica*), 82; pygmy weasel (*Mustela rixosa*), 82; raccoon dog (*Nyctereutes*), 85; red fox (*Vulpes*), 86; wolf (*Canis*), 84.

EVEN-TOED UNGULATES. pig (*Sus*), 149; serow (*Capricornis*), 142; sika deer (*Cervus sika*), 146.

INSECTIVORES. mole (*Mogera*), 41; red-toothed shrew (*Sorex*), 40; shrew-moles (*Urotrichus, Dymecodon*), 42; water shrew (*Chimarrogale*), 41; white-toothed shrew (*Suncus*), 40.

MONKEYS. Japanese macaque (*Macaca fuscata*), 67.

RABBITS. Japanese hare (*Lepus brachyurus*), 124; pika or mouse-hare (*Ochotona*), 126; varying hare (*Lepus timidus*), 124.

RODENTS. chipmunk (*Eutamias*), 111; common rats (*Rattus*), 114; Eurasian squirrel (*Sciurus*), 110; flying squir-

rels (*Petaurista, Pteromys*), 109; house mouse (*Mus*), 113; Japanese dormouse (*Glirulus*), 112; Japanese vole or meadow mouse (*Microtus*), 120; red-backed mouse (*Clethrionomys*), 120; wood mouse (*Apodemus*), 114.

SEALS, SEA LIONS. Japanese sea lion (*Zalophus*), 100; northern fur seal (*Callorhinus*), 102; Pacific harbor seal (*Phoca*), 104.

Japan Sea

WHALES. Baird whale (*Berardius*), 130; blackfish or pilot whale (*Globiocephalus*), 132; blue whale (*Sibbaldus*), 128; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; finback or sei whale (*Balænoptera*), 128; finless black porpoise (*Neomeris*), 132; gray or Risso's dolphin (*Grampus*), 131; gray whale (*Rhachianectes*), 128; humpback whale (*Megaptera*), 128; killer whale (*Orcinus*), 131; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129; True's porpoise (*Phocænoides*), 132; white-sided porpoise (*Lagenorhynchus*), 133.

Java

BATS. bent-winged bat (*Miniopterus*), 59; common bat (*Myotis, Pipistrellus, Glischropus, Tylonycteris, Scotophilus*), 55; free-tailed bats (*Tadarida, Cheiromeles*), 62; false vampire (*Megaderma*), 53; flying foxes (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bats (*Hipposideros, Cœlops*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bats (*Emballonura, Saccolaimus, Taphozous*), 51; short-nosed fruit bats (*Cynopterus, Chironax*), 48; slit-faced bat (*Nycteris*), 52; trumpet eared bats (*Kerivoula, Phoniscus*), 61; tube-nosed bats (*Murina, Harpiocephalus*), 59.

CARNIVORES. Asiatic wild dog (*Cuon*), 85; binturong (*Arctictis*), 91; civet (*Viverricula*), 87; Eurasian otter (*Lutra lutra*), 84; ferret badger (*Helictis*), 83; fishing cat (*Felis viverrina*), 98; Java weasel (*Mustela*), 82; leopard (*Felis pardus*), 95; leopard cat (*Felis bengalensis*), 98; linsang (*Prionodon*), 88; Malay badger (*Mydaus*), 83; mongooses

(*Herpestes*), 94; palm civet (*Paradoxurus*), 89; small-clawed otter (*Lutra cinerea*), 84; small-toothed palm civet (*Arctogalidia*), 92; tiger (*Felis tigris*), 95; yellow-throated marten (*Martes*), 81.

DUGONG (*Dugong*), 136.

EVEN–TOED UNGULATES. banting (*Bibos*), 139; mouse deer (*Tragulus*), 149; muntjac (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144.

FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.

INSECTIVORES. Gymnure or rat-like insectivore (*Hylomys*), 38; tree shrew (*Tupaia*), 43; white-toothed shrews (*Crocidura, Suncus*), 40.

ODD–TOED UNGULATES. Javan one-horned rhinoceros (*Rhinoceros*), 151.

MONKEYS, APES, LEMURS. gray gibbon (*Hylobates moloch*), 66; leaf monkeys (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; slow loris (*Nycticebus*), 76.

RABBITS. black-naped hare (*Lepus*), 124.

RODENTS. bandicoot rat (*Bandicota*), 115; common rats (*Rattus*), 114; complex-toothed tree mouse (*Chiropodomys*), 116; flying squirrels (*Petaurista, Iomys, Hylopetes, Petinomys*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110; porcupine (*Hystrix*), 121; red tree rat (*Pithecheir*), 115; shrew-rat (*Mycteromys*), 115; striped ground squirrel (*Lariscus*), 111.

SCALY ANTEATER (*Manis*), 107.

WHALES. blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; Cuvier's or goose-beaked whale (*Ziphius*), 131; finback (*Balænoptera*), 128; finless black porpoise (*Neomeris*), 132; Irrawaddi dolphin (*Orcella*), 132; killer (*Orcinus*), 131; lead-colored dolphin (*Sotalia*), 135; long-beaked dolphin (*Steno*), 135; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129.

Juan Fernandez Island, Southeast Pacific

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

SEALS, SEA LIONS. elephant seal (*Mirounga*), 105; southern fur seal (*Arctocephalus*), 103; southern sea lion (*Otaria*), 101.

Kangean Islands, Java Sea

BATS. common bat (*Pipistrellus*), 56; false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; long-tongued bat (*Macroglossus*), 49; short-nosed fruit bat (*Cynopterus*), 48; trumpet-eared bat (*Kerivoula*), 61.
CARNIVORES. civet (*Viverricula*), 87; leopard (*Felis pardus*), 95; palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. muntjac or barking deer (*Muntiacus*), 147.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Karimata Island, West Borneo

BATS. common bat (*Myotis*), 55; false vampire (*Megaderma*), 53; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; sheath-tailed bat (*Emballonura*), 51.
CARNIVORES. civet (*Viverra*), 86.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrew (*Tupaia*), 43.
MONKEYS. leaf monkey (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.
SCALY ANTEATER (*Manis*), 107.

Kei Islands, Banda Sea

BATS. common bat (*Myotis*), 55; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus*, *Syconycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48.

MARSUPIALS. cuscus (*Phalanger*), 25; spiny bandicoot (*Echymipera*), 21; tree kangaroo (*Dendrolagus*), 34; wallaby (*Thylogale*), 32.
RODENTS. common rat (*Rattus*), 114; giant rat (*Uromys*), 116; house mouse (*Mus*), 113; water rat (*Hydromys*), 118.

Komodo Island, Lesser Sundas

EVEN-TOED UNGULATES. pig (*Sus*), 149; Sambar deer (*Cervus*), 144.
INSECTIVORES. white-toothed shrew (*Crocidura*), 40.

Kurile Islands, North Japan

BATS. common bats (*Myotis, Plecotus*), 55.
CARNIVORES. Arctic fox (*Alopex*), 86; Eurasian bear (*Ursus*), 79; pygmy weasel (*Mustela rixosa*), 82; red fox (*Vulpes*), 86; sea otter (*Enhydra*), 84.
INSECTIVORES. red-toothed shrew (*Sorex*), 40.
RABBITS. varying hare (*Lepus*), 124.
RODENTS. chipmunk (*Eutamias*), 111; common rat (*Rattus*), 114; house mouse (*Mus*), 113; meadow mouse (*Microtus*), 120; red-backed mouse (*Clethrionomys*), 120; wood mouse (*Apodemus*), 114.
SEALS, SEA LIONS. harbor seal (*Phoca vitulina*), 104; northern fur seal (*Callorhinus*), 102; ribbon seal (*Phoca fasciata*), 104; Steller's sea lion (*Eumetopias*), 101; walrus (*Odobenus*), 106

Lingga Archipelago, see Rhio-Lingga Archipelago

Liu Kiu Islands, see Luchu Islands

Lombok, Lesser Sundas

BATS. flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; short-nosed fruit bat (*Cynopterus*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; porcupine (*Hystrix*), 121.

Louisiade Islands, see D'Entrecasteaux Islands

Loyalty Islands, see New Caledonia

Luchu Islands (Liu Kiu or Riu Kiu Islands), South of Japan

BATS. bent-winged bats (*Miniopterus*), 59; flying fox (*Pteropus*), 48; horseshoe bats (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53.
CARNIVORES. Oriental weasel (*Mustela siberica*), 82.
EVEN-TOED UNGULATES. pig (*Sus*), 149; Sika deer (*Cervus*), 146.
INSECTIVORES. red-toothed shrew (*Sorex*), 40; white-toothed shrew (*Suncus*), 40.
RABBITS. Luchu hare (*Pentalagus*), 125.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; wood mouse (*Apodemus*), 114.

Macassar Strait, Borneo—Celebes

DUGONG (*Dugong*), 136.
WHALES. finback whale (*Balænoptera*), 128; Irrawaddi dolphin (*Orcella*), 132; sperm whale (*Physeter*), 129.

Madura Island, East Java

BATS. horseshoe bat (*Rhinolophus*), 53. (Most Javan species are to be expected.)
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Manihiki Islands, Polynesia

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Mariana Islands, Micronesia

BATS. flying fox (*Pteropus*), 48.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Marquesas Islands, Polynesia

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Marshall Islands, Micronesia

BATS. sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Mata Siri Island, Java Sea

BATS. flying fox (*Pteropus*), 48; short-nosed fruit bat (*Cynopterus*), 48.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Melanesian Area, Pacific Ocean

DUGONG (*Dugong*), 136.
WHALES. blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; false killer (*Pseudorca*), 132; finback (*Balænoptera*), 128; humpback (*Megaptera*), 128; killer whale (*Orcinus*), 131; sperm whale (*Physeter*), 129.

Mendanau Island, Java Sea

BATS. common bat (*Myotis*), 55.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Mentawi Islands (including Pagi Islands), West Sumatra

BATS. common bat (*Myotis*), 55; false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49;

sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bat (*Cynopterus*), 48; trumpet-eared bat (*Kerivoula*), 61.
CARNIVORES. banded palm civet (*Hemigalus*), 93; palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. sambar deer (*Cervus*), 144.
INSECTIVORES. tree shrew (*Tupaia*), 43.
MONKEYS, APES, LEMURS. dwarf gibbon (*Hylobates klossi*), 65; Mentawi leaf monkey (*Presbytis potenziani*), 73; pig-tailed langur (*Simias*), 75; pig-tailed macaque (*Macaca nemestrina*), 67; slow loris (*Nycticebus*), 76.
RODENTS. common rats (*Rattus*), 114; flying squirrels (*Iomys, Hylopetes, Petinomys*), 109; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; striped ground squirrel (*Lariscus*), 111.
SCALY ANTEATER (*Manis*), 107.

Micronesian Area, Pacific Ocean

DUGONG (*Dugong*), 136.
WHALES. blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; false killer (*Pseudorca*), 132; finback (*Balænoptera*), 128; humpback (*Megaptera*), 128; killer (*Orcinus*), 131; sperm whale (*Physeter*), 129.

Molucca Islands (Gilolo group, Ceram and Buru are listed separately)

BATS. common bats (*Myotis, Glischropus*), 55; flying foxes (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bat (*Thoöpterus*), 48; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bat (*Kerivoula*), 61; tube-nosed fruit bat (*Nyctimene*), 48.
EVEN-TOED UNGULATES. Sambar deer (*Cervus*), 144.
INSECTIVORES. white-toothed shrew (*Crocidura*), 40.
MARSUPIALS. cuscus phalanger (*Phalanger*), 25; flying phalanger (*Petaurus*), 27.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; mosaic-tailed rats (*Melomys*), 116.

Navigator Islands, see Samoa Islands

New Britain, Bismarck Group

BATS. common bat (*Pipistrellus*), 56; flying foxes (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Syconycteris, Melonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; tube-nosed bat (*Nyctimene*), 48.

MARSUPIALS. cuscus (*Phalanger*), 25; flying phalanger or possum (*Petaurus*), 27; spiny bandicoot (*Echymipera*), 21; wallaby (*Thylogale*), 33.

RODENTS. common rats (*Rattus*), 114; giant rats (*Uromys*), 116; house mouse (*Mus*), 113; mosaic-tailed rats (*Melomys*), 116; water rat (*Hydromys*), 118.

New Caledonia (including the Loyalty Islands)

BATS. bent-winged bat (*Miniopterus*), 59; common bat (*Chalinolobus*), 58; flying foxes (*Pteropus*), 48; long-tailed bat (*Notopteris*), 50; sheath-tailed bat (*Emballonura*), 51.

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

New Guinea (including adjacent islands)

BATS. Australian long-eared bats (*Nyctophilus, Pharotis*), 60; bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Philetor, Scoteinus, Chalinolobus*), 55; flying foxes (*Pteropus*), 48; free-tailed bat (*Tadarida*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Syconycteris, Melonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bats (*Emballonura, Saccolaimus, Taphozous*), 51; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bats (*Kerivoula, Phoniscus*), 61; tube-nosed fruit bats (*Nyctimene, Paranyctimene*), 48.

EGG–LAYING MAMMALS. spiny anteaters (*Tachyglossus, Zaglossus*), 14.

EVEN-TOED UNGULATES. sambar deer (*Cervus*), 144; pig (*Sus*), 149.

MARSUPIALS. bandicoots (*Isoodon, Peroryctes, Microperoryctes, Echymipera*), 21; cuscus phalangers (*Phalanger*), 25; dormouse possum or phalanger (*Eudromicia*), 25; feather-tailed possum or phalanger (*Distoechurus*), 25; flying possum (*Petaurus*), 27; marsupial cat (*Dasyurus*), 19; marsupial mice (*Sminthopsis, Phascogale*), 20; ring-tailed possum (*Pseudocheirus*), 26; striped possums (*Dactylopsila, Dactylonax*), 24; tree kangaroo (*Dendrolagus*), 34; wallabies (*Wallabia, Thylogale, Dorcopsis*), 32.

RODENTS. common rats (*Rattus*), 114; complex-toothed rats (*Mallomys, Pogonomys*), 116; giant rats (*Hyomys, Anisomys, Uromys*), 116; house mouse (*Mus*), 113; mosaic-tailed rat (*Melomys*), 116; water rats (*Hydromys, Leptomys, Pseudohydromys*), 118.

New Hebrides, Melanesia

BATS. flying foxes (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; long-tailed bat (*Notopteris*), 50; sheath-tailed bat (*Emballonura*), 51.

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

New Ireland, Bismarck Group

BATS. common bat (*Pipistrellus*), 56; flying foxes (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Syconycteris, Melonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48.

MARSUPIALS. cuscus (*Phalanger*), 25; spiny bandicoot (*Echymipera*), 21; wallaby (*Thylogale*), 33.

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

New Zealand

BATS. common bat (*Chalinolobus*), 56; New Zealand bat (*Mystacops*), 61.

EVEN–TOED UNGULATES. axis deer, 146; chamois, 143; blue sheep, 144; European red deer, 146; fallow deer, 146; Himalayan tahr, 144; moose, 146; mule deer, 146; sambar, 144; sika deer, 146; Virginia deer, 146; wapiti, 146.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.
SEALS, SEA LIONS. crab-eating seal (*Lobodon*), 105; New Zealand fur seal (*Arctocephalus*), 103; sea leopard (*Hydrurga*), 104; Weddel seal (*Leptonychotes*), 105.

Nias Island, West Sumatra

BATS. common bats (*Myotis, Pipistrellus*), 55; false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bat (*Macroglossus*), 49; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bats (*Cynopterus, Chironax*), 48; tube-nosed bat (*Murina*), 59.
CARNIVORES. binturong (*Arctictis*), 91; leopard cat (*Felis bengalensis*), 98.
EVEN–TOED UNGULATES. mouse deer (*Tragulus*), 149; muntjac or barking deer (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144.
INSECTIVORES. tree shrew (*Tupaia*), 43.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rat (*Rattus*), 114; complex-toothed tree rat (*Chiropodomys*), 116; house mouse (*Mus*), 113.
SCALY ANTEATER (*Manis*), 107.

Norfolk Island, Northwest of New Zealand

BATS. common bat (*Chalinolobus*), 56; free-tailed bat (*Tadarida*), 62.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

North Natuna Islands, South China Sea

BATS. false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bat (*Macroglossus*), 49;

sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bat (*Cynopterus*), 48.
CARNIVORES. Malay badger (*Mydaus*), 83; small-toothed palm civet (*Arctogalidia*), 92.
EVEN-TOED UNGULATES. Mouse deer (*Tragulus*), 149; pig (*Sus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrew (*Tupaia*), 43.
MONKEYS, LEMURS. leaf-monkey (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; slow loris (*Nycticebus*), 76.
RODENTS. common rats (*Rattus*), 114; complex-toothed tree rat (*Chiropodomys*), 116; flying squirrels (*Petaurista, Hylopetes*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; Oriental squirrel (*Callosciurus*), 110.
SCALY ANTEATER (*Manis*), 107.

North Pacific Ocean

WHALES. Baird whale (*Berardius*), 130; beaked whales (*Mesoplodon*), 131; blackfish or pilot whale (*Globiocephalus*), 132; blue whale (*Sibbaldus*), 128; bottle-nosed dolphin (*Tursiops*), 134; bowhead (*Balæna*), 127; common dolphin (*Delphinus*), 134; Dall's porpoise (*Phocænoides dalli*), 132; false killer (*Pseudorca*), 132; finback (*Balænoptera*), 128; gray or Risso's dolphin (*Grampus*), 131; gray whale (*Rhachianectes*), 128; humpback (*Megaptera*), 128; killer (*Orcinus*), 131; northern right whale (*Eubalæna*), 127; northern right whale dolphin (*Lissodelphis*), 133; pygmy sperm whale (*Kogia*), 130; sperm whale (*Physeter*), 129; True's porpoise (*Phocœnoides truei*), 132; white-sided dolphin (*Lagenorhynchus*), 133.

Obi Island, see Molucca Islands

Ogasawara Shoto, see Bonin Islands

Okhotsk Sea

WHALES. blackfish or pilot whale (*Globiocephalus*), 132; bowhead (*Balæna*), 127; common dolphin (*Delphinus*),

134; finback (*Balænoptera*), 128; gray or Risso's dolphin (*Grampus*), 131; gray whale (*Rhachianectes*), 128; killer (*Orcinus*), 131; northern right whale (*Eubalæna*), 127; sperm whale (*Physeter*), 129; True's porpoise (*Phocœnoides truei*), 132.

Ombay Island, see Alor

Pagi Islands, see Mentawi Islands

Palau Islands (Pelews), Micronesia

BATS. flying foxes (*Pteropus*), 48; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Palawan Island (including the Calamianes and Balabac), the Philippines

BATS. common bats (*Myotis, Pipistrellus, Glischropus, Tylonycteris, Scotophilus*), 55; flying foxes (*Pteropus, Acerodon*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bat (*Macroglossus*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bats (*Emballonura, Taphozous*), 51; short-faced fruit bat (*Cynopterus*), 48; trumpet-eared bat (*Kerivoula*), 61.
CARNIVORES. binturong (*Arctictis*), 91; leopard cat (*Felis bengalensis*), 98; Malay badger (*Mydaus*), 83; mongoose (*Herpestes*), 94; palm civet (*Paradoxurus*), 89; small-clawed otter (*Lutra cinerea*), 84.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149; pig (*Sus*), 149; sambar deer (*Cervus*), 144.
INSECTIVORES. tree shrew (*Tupaia*), 43; white-toothed shrews (*Crocidura, Suncus*), 40.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; complex-toothed tree rat (*Chiropodomys*), 116; flying squirrel (*Hylopetes*), 109; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; porcupine (*Hystrix*), 121.
SCALY ANTEATER (*Manis*), 107.

Pelew Islands, see Palau Islands

Perry Group, see Bonin Islands

Philippine Islands (excluding Palawan)

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Glischropus, Nyctalus, Tylonycteris, Scotophilus*), 55; false vampire (*Megaderma*), 53; flying foxes (*Pteropus, Acerodon*), 48; free-tailed bats (*Tadarida, Cheiromeles*), 62; harpy fruit bat (*Harpionycteris*), 49; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bats (*Emballonura, Taphozous, Taphonycteris*), 51; short-faced fruit bats (*Cynopterus, Megaerops, Ptenochirus*), 48; spinal-winged bat (*Dobsonia*), 48; trumpet-eared bat (*Kerivoula*), 61; tube-nosed bat (*Murina*), 59.

CARNIVORES. civet (*Viverra*), 86; leopard cat (*Felis bengalensis*), 98; palm civet (*Paradoxurus*), 89.

EVEN-TOED UNGULATES. pig (*Sus*), 149; sambar deer (*Cervus*), 144; tamarau (*Bubalus mindorensis*), 141.

FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.

INSECTIVORES. gymnure or rat-like insectivore (*Podogymnura*), 39; tree shrew (*Urogale*), 44; white-toothed shrews (*Crocidura, Suncus*), 40.

MONKEYS, LEMURS. long-tailed macaque (*Macaca irus*), 67; slow loris (*Nycticebus*), 76; tarsier (*Tarsius*), 78.

RODENTS. bushy-tailed rats (*Phlœomys, Crateromys*), 117; common rats (*Rattus, Apomys, Tryphomys, Tarsomys, Carpomys, Batomys*), 114; flying squirrel (*Petinomys*), 109; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110; shrew rat (*Rhynchomys*), 116; water rats (*Chrotomys, Celœnomys, Crunomys*), 118.

Phoenix Islands, Polynesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Pitcairn and associated islands, Polynesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Rhio-Lingga Archipelago, East Sumatra

BATS. common bats (*Myotis, Nyctalus, Scotophilus*), 55; false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; naked free-tailed bat (*Cheiromeles*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; sheath-tailed bat (*Emballonura*), 51; short-nosed fruit bats (*Cynopterus, Balionycteris, Penthetor*), 48.
CARNIVORES. binturong (*Arctictis*), 91; civet (*Viverra*), 86; palm civet (*Paradoxurus*), 89; small-clawed otter (*Lutra cinerea*), 84; small-toothed palm civet (*Arctogalidia*), 92.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149; muntjac (*Muntiacus*), 147; pig (*Sus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrew (*Tupaia, Ptilocercus*), 43; white-toothed shrew (*Crocidura*), 40.
MONKEYS, LEMURS. leaf monkeys (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; slow loris (*Nycticebus*), 76.
RODENTS. common rat (*Rattus*), 114; flying squirrels (*Petaurista, Hylopetes, Petinomys*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; Oriental squirrel (*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110; striped ground squirrel (*Lariscus*), 111.
SCALY ANTEATER (*Manis*), 107.

Riu Kiu Islands, see Luchu Islands

Saint Esprit Island, see Tambelan Islands

Sakhalin Island, Sea of Okhotsk

BATS. common bat (*Myotis*), 55.
CARNIVORES. ermine or stoat (*Mustela erminea*), 81; Eurasian bear (*Ursus*), 79; lynx (*Lynx*), 99; sable (*Martes*

zibellina), 81; tiger (*Felis tigris*), 95; wolf (*Canis lupus*), 84; wolverine (*Gulo*), 82.
EVEN-TOED UNGULATES. musk deer (*Moschus*), 147; reindeer (*Rangifer*), 146.
INSECTIVORES. red-toothed shrew (*Sorex*), 40.
RABBITS. varying hare (*Lepus timidus*), 124; pika (*Ochotona*), 126.
RODENTS. chipmunk (*Eutamias*), 111; common rat (*Rattus*), 114; Eurasian squirrel (*Sciurus*), 110; flying squirrel (*Pteromys*), 109; house mouse (*Mus*), 113; red-backed mouse or vole (*Clethrionomys*), 120; striped tree mouse (*Sicista*), 121; wood mouse (*Apodemus*), 114.
SEALS, SEA LIONS. harbor seal (*Phoca vitulina*), 104; ringed seal (*Phoca hispida*), 104.

Saleyer (Salajar) Island, South of Celebes

BATS. flying foxes (*Pteropus, Acerodon*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149.
MARSUPIALS. cuscus phalanger (*Phalanger*), 26.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Samoa (Navigator) Islands, Polynesia

BATS. common bat (*Myotis*), 55; flying foxes (*Pteropus*), 48; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Sanghir (Sangihe) Islands, North of Celebes

BATS. flying foxes (*Pteropus, Acerodon*), 48; long-tongued bat (*Macroglossus*), 49; rousette or dog bat (*Rousettus*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
MARSUPIALS. cuscus (*Phalanger*), 25.
MONKEYS, LEMURS. tarsier (*Tarsius*), 78.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Santa Cruz Islands, Melanesia

BATS. flying fox (*Pteropus*), 48; leaf-nosed bat (*Hipposideros*), 53; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Ste. Barbe Island, South China Sea

BATS. leaf-nosed bat (*Hipposideros*), 53.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Savu (Savoe) Island, Lesser Sundas

BATS. flying fox (*Pteropus*), 48; rousette or dog bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Simalu (Simeuloeë or Babi) Island, West Sumatra

BATS. false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; naked free-tailed bat (*Cheiromeles*), 62; sheath-tailed bat (*Emballonura*), 51; short-faced fruit bat (*Cynopterus*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Society Islands, Polynesia

RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Soela Islands, included in Molucca Islands

Solombo Island, Java Sea

BATS. flying fox (*Pteropus*), 48.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Solomon Islands, Melanesia

BATS. common bat (*Pipistrellus*), 56; flying foxes (*Pteropus, Pteralopex*), 48; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Nesonycteris*), 49; rousette bat (*Rousettus*), 48; sheath-tailed bat (*Emballonura*), 51; spinal-winged bat (*Dobsonia*), 48; tube-nosed bat (*Nyctimene*), 48.
MARSUPIALS. cuscus (*Phalanger*), 25.
RODENTS. common rats (*Rattus*), 114; giant rats (*Uromys*), 116; house mouse (*Mus*), 113; mosaic-tailed rats (*Melomys*), 116.

South China Sea

DUGONG (*Dugong*), 136.
WHALES. bottle-nosed dolphin (*Tursiops*), 134; Chinese white dolphin (*Sotalia sinensis*), 135; common dolphin (*Delphinus*), 134; finback (*Balœnoptera*), 128; finless black porpoise (*Neomeris*), 132; gray or Risso's dolphin (*Grampus*), 131; humpback (*Megaptera*), 128; Irrawaddi dolphin (*Orcella*), 132; Malay white dolphin (*Sotalia borneensis*), 135; pygmy sperm whale (*Kogia*), 130; slender dolphin (*Prodelphinus*), 135; sperm whale (*Physeter*), 129.

South Natuna Islands, South China Sea

BATS. common bats (*Myotis, Pipistrellus*), 55; false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; short-nosed fruit bat (*Cynopterus*), 48.
EVEN-TOED UNGULATES. mouse deer (*Tragulus*), 149.
FLYING LEMUR. colugo, caguan (*Cynocephalus*), 44.
INSECTIVORES. tree shrew (*Tupaia, Ptilocercus*), 43; white-toothed shrew (*Crocidura*), 40.
MONKEYS, LEMURS. leaf monkey (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; tarsier (*Tarsius*), 78.
RODENTS. common rats (*Rattus*), 114; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; Oriental squirrel (*Callosciurus*), 110.

South Pacific Ocean (30° to 50° South Latitude)

WHALES. beaked whales (*Mesoplodon, Berardius*), 131; blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; Cuvier's or goose-beaked whale (*Ziphius*), 131; dusky dolphin (*Lagenorhynchus obscurus*), 134; false killer (*Pseudorca*), 132; finback (*Balænoptera*), 128; gray or Risso's dolphin (*Grampus*), 131; Hector's dolphin (*Cephalorhynchus hectori*), 133; hour-glass dolphin (*Lagenorhynchus cruciger*), 133; humpback (*Megaptera*), 128; killer whale (*Orcinus*), 131; pygmy right whale (*Neobalæna*), 128; pygmy sperm whale (*Kogia*), 130; right whale dolphin (*Lissodelphis*), 133; southern right whale (*Eubalæna*), 127; sperm whale (*Physeter*), 129; white-headed dolphin (*Cephalorhynchus albifrons*), 133.

Sula (Soela, Xulla) Islands, see Molucca Islands

Sumatra

BATS. bent-winged bat (*Miniopterus*), 59; common bats (*Myotis, Pipistrellus, Glischropus, Tylonycteris, Nyctalus, Scotophilus*), 55; false vampire (*Megaderma*), 53; flying foxes (*Pteropus*), 48; free-tailed bats (*Tadarida, Mormopterus, Cheiromeles*), 62; horseshoe bat (*Rhinolophus*), 53; leaf-nosed bat (*Hipposideros*), 53; long-tongued bats (*Macroglossus, Eonycteris*), 49; mouse-tailed bat (*Rhinopoma*), 51; rousette bat (*Rousettus*), 48; sheath-tailed bats (*Emballonura, Saccolaimus, Taphozous*), 51; short-faced fruit bats (*Cynopterus, Dyacopterus, Megaerops, Aethalops, Chironax*), 48; trumpet-eared bats (*Kerivoula, Phoniscus*), 61; tube-nosed bats (*Murina, Harpiocephalus*), 59.

CARNIVORES. Asiatic wild dog (*Cuon*), 85; banded palm civet (*Hemigalus*), 93; bare-footed weasel (*Mustela*), 82; binturong (*Arctictis*), 91; civets (*Viverra, Viverricula*), 86; clouded leopard (*Felis nebulosa*), 96; Eurasian otter (*Lutra lutra*), 84; fishing cat (*Felis viverrina*), 98; flat-headed cat (*Felis planiceps*), 98; golden cat (*Felis tem-*

minckii), 97; hairy-nosed otter (*Lutra sumatrana*), 84; hog-nosed badger (*Arctonyx*), 83; Java weasel (*Mustela*), 82; leopard cat (*Felis bengalensis*), 98; linsang (*Prionodon*), 88; Malay badger (*Mydaus*), 83; Malay bear (*Helarctos*), 80; marbled cat (*Felis marmorata*), 96; masked palm civet (*Paguma*), 91; mongooses (*Herpestes*), 94; otter civet (*Cynogale*), 93; palm civet (*Paradoxurus*), 89; small-clawed otter (*Lutra cinerea*), 84; small-toothed palm civet (*Arctogalidia*), 92; smooth otter (*Lutra perspicillata*), 84; tiger (*Felis tigris*), 95; yellow-throated marten (*Martes*), 81.

ELEPHANT (*Elephas*), 136.

EVEN–TOED UNGULATES. mouse deer (*Tragulus*), 149; muntjac or barking deer (*Muntiacus*), 147; pig (*Sus*), 149; sambar deer (*Cervus*), 144; serow (*Capricornis*), 142.

FLYING LEMUR. colugo, caguan (*Cynocephalus*), 144.

INSECTIVORES. gymnures or rat-like insectivores (*Echinosorex, Hylomys*), 38; tree shrews (*Tupaia, Ptilocercus*), 43; water shrew (*Chimarrogale*), 41; white-toothed shrews (*Crocidura, Suncus*), 40.

ODD–TOED UNGULATES. Javan one-horned rhinoceros (*Rhinoceros*), 151; Sumatran two-horned rhinoceros (*Dicerorhinus*), 153; tapir (*Tapirus*), 154.

MONKEYS, APES, LEMURS. dark-handed gibbon (*Hylobates agilis*), 66; leaf monkeys (*Presbytis*), 70; long-tailed macaque (*Macaca irus*), 67; orang-utan (*Pongo*), 63; pig-tailed macaque (*Macaca nemestrina*), 67; siamang gibbon (*Hylobates syndactylus*), 64; slow loris (*Nycticebus*), 76; tarsier (*Tarsius*), 78; white-handed gibbon (*Hylobates lar*), 66.

RABBITS. striped rabbit or Sumatran hare (*Nesolagus*), 125.

RODENTS. Bamboo rats (*Rhizomys*), 112; bandicoot rats (*Bandicota*), 115; brush-tailed porcupine (*Atherurus*), 122; common rats (*Rattus*), 114; complex-toothed tree rat (*Chiropodomys*), 116; flying squirrels (*Petaurista, Iomys, Pteromyscus, Hylopetes, Petinomys, Aeromys*), 109; giant squirrel (*Ratufa*), 110; house mouse (*Mus*), 113; long-nosed ground squirrel (*Rhinosciurus*), 112; long-tailed porcupine (*Trichys*), 122; Oriental squirrel

(*Callosciurus*), 110; pygmy squirrel (*Nannosciurus*), 110; porcupine (*Hystrix*), 121; red tree rat (*Pithecheir*), 115; shrew rat (*Mycteromys*), 115; striped ground squirrel (*Lariscus*), 111.
SCALY ANTEATER (*Manis*), 107.

Sumba (Soemba) Island, Lesser Sundas

BATS. flying foxes (*Pteropus, Acerodon*), 48; spinal-winged bat (*Dobsonia*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. sambar deer (*Cervus*), 144.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113.

Sumbawa (Soembawa) Island, Lesser Sundas

BATS. flying foxes (*Pteropus, Acerodon*), 48.
CARNIVORES. civet (*Viverricula*), 87; palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. sambar deer (*Cervus*), 144.
RODENTS. common rat (*Rattus*), 114; house mouse (*Mus*), 113; porcupine (*Hystrix*), 121.

Talaut Island, North of the Moluccas

BATS. flying foxes (*Pteropus, Acerodon*), 48.
MARSUPIALS. cuscus phalanger (*Phalanger*), 25.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; mosaic-tailed rats (*Melomys*), 116.

Tambelan Islands, West Borneo, including Saint Esprit Island

BATS. false vampire (*Megaderma*), 53; flying fox (*Pteropus*), 48.
INSECTIVORES. tree shrews (*Tupaia*), 43.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113; Oriental squirrel (*Callosciurus*), 110.

Tanimber Island (Timor Laut), Arafura Sea

BATS. flying fox (*Pteropus*), 48; tube-nosed fruit bat (*Nyctimene*), 48.

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Tasman Sea, Southwest Pacific

WHALES. beaked whales (*Mesoplodon, Berardius*), 131; blackfish or pilot whale (*Globiocephalus*), 132; bottle-nosed dolphin (*Tursiops*), 134; common dolphin (*Delphinus*), 134; Cuvier's or goose-beaked whale (*Ziphius*), 131; dusky dolphin (*Lagenorhynchus obscurus*), 134; false killer (*Pseudorca*), 132; finback (*Balænoptera*), 128; gray or Risso's dolphin (*Grampus*), 131; Hector's dolphin (*Cephalorhynchus hectori*), 133; hour-glass dolphin (*Lagenorhynchus cruciger*), 133; humpback (*Megaptera*), 128; killer (*Orcinus*), 131; pygmy right whale (*Neobalæna*), 128; pygmy sperm whale (*Kogia*), 130; right whale dolphin (*Lissodelphis*), 133; southern right whale (*Eubalæna*), 127; sperm whale (*Physeter*), 129; white-headed dolphin (*Cephalorhynchus albifrons*), 133.

Tasmania

BATS. Australian long-eared bat (*Nyctophilus*), 60; common bats (*Pipistrellus, Eptesicus, Chalinolobus*), 56.

EGG–LAYING MAMMALS. duckbill or platypus (*Ornithorhynchus*), 11; spiny anteater or echidna (*Tachyglossus*), 14.

MARSUPIALS. bandicoots (*Isoodon, Perameles*), 21; dormouse possum (*Dromicia*), 25; flying possum (*Petaurus*), 27; large kangaroo (*Macropus*), 31; marsupial mice and rats (*Antechinus, Sminthopsis*), 20; native cat (*Dasyurus*), 19; possum (*Trichosurus*), 23; rat kangaroos (*Bettongia, Potorous*), 36; ring-tailed possum (*Pseudocheirus*), 26; Tasmanian devil (*Sarcophilus*), 18; Tasmanian wolf (*Thylacinus*), 17.

SEALS, SEA LIONS. fur seal (*Arctocephalus*), 103; seals (*Hydrurga, Lobodon, Leptonychotes*), 104; sea lion (*Neophoca*), 101.

RODENTS. broad-toothed rat (*Mastocomys*), 117; common rats (*Rattus*), 114; house mouse (*Mus*), 113; native mice (*Pseudomys*), 117; water rat (*Hydromys*), 118.

Timor, Lesser Sundas

BATS. Australian long-eared bat (*Nyctophilus*), 60; bent-winged bat (*Miniopterus*), 59; common bat (*Tylonycteris*), 57; flying foxes (*Pteropus, Acerodon*), 48; leaf-nosed bat (*Hipposideros*), 53; rousette or dog bat (*Rousettus*), 48; slit-faced bat (*Nycteris*), 52; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48.
CARNIVORES. palm civet (*Paradoxurus*), 89.
EVEN-TOED UNGULATES. pig (*Sus*), 149; sambar deer (*Cervus*), 144.
INSECTIVORES. white-toothed shrews (*Crocidura, Suncus*), 40.
MARSUPIALS. cuscus (*Phalanger*), 25.
MONKEYS. long-tailed macaque (*Macaca irus*), 67.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Timor Laut, see Tanimber Island

Tonga (Friendly) Islands, Polynesia

BATS. flying fox (*Pteropus*), 48.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Torres Strait, see Arafura Sea

Trobriand Islands, see D'Entrecasteaux Islands

Union Islands, Polynesia

RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Vulcano Islands, see Bonin Islands

Wake Island, Micronesia

SEALS. Hawaiian monk seal (*Monachus*), 105.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

West Pacific Ocean, see Micronesian Area, Pacific Ocean

Wetar (Wetter) Island, North of Timor

BATS. flying foxes (*Pteropus, Acerodon*), 48; rousette or dog bat (*Rousettus*), 48; spinal-winged bat (*Dobsonia*), 48; tube-nosed fruit bat (*Nyctimene*), 48.
MARSUPIALS. cuscus (*Phalanger*), 25.
RODENTS. common rats (*Rattus*), 114; house mouse (*Mus*), 113.

Xulla Islands, see Molucca Islands

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